Preparing herbarium specimens

Lyn Fish

Strelitzia 7

STRELITZIA 7

Preparing herbarium specimens

by

Lyn Fish

NASIONALE BOTANIESE INSTITUUT
Private Bag
1993 -04- 07
Privaatsak

Scientific editor: G. Germishuizen
Technical editor: E. du Plessis

NATIONAL BOTANICAL INSTITUTE

Pretoria

1999

MARY GUNN LIBRARY
0000029614
South African National Biodiversity Institute

STRELITZIA

This series has replaced *Memoirs of the Botanical Survey of South Africa* and *Annals of Kirstenbosch Botanic Gardens* which the NBI inherited from its predecessor organisations.

The genus *Strelitza* occurs naturally in the eastern parts of southern Africa. It comprises three arborescent species, known as wild bananas, and two acaulescent species, known as crane flowers or bird-of-paradise flowers. The logo of the National Botanical Institute is based on the striking inflorescence of *Strelitzia reginae*, a native of the Eastern Cape and KwaZulu-Natal that has become a garden favourite worldwide. It symbolises the commitment of the National Botanical Institute to promote the sustainable use, conservation, appreciation and enjoyment of the exceptionally rich plant life of South Africa, for the benefit of all its people.

Cover
Design: S. Turck
Photography: A. Romanowski

ISBN 1-919795-38-3

© Published by and obtainable from: National Botanical Institute, Private Bag X101, Pretoria, 0001 South Africa. Typesetting and layout by S.S. Brink (NBI). Reproduction by 4Images, P.O. Box 34059, Glenstantia, Pretoria, 0010. Printing by BM Printing, P.O. Box 27056, Benrose 2011.

CONTENTS

ABSTRACT v
1. INTRODUCTION 1
1.1 Aim of the book 1
1.2 Herbarium: what and why 2
1.3 Importance of making good herbarium specimens 2
2. COLLECTING 4
2.1 Planning 4
2.2 Type of collecting 4
2.3 Who collects plant material for preparation of herbarium specimens? 4
2.4 Restrictions on collecting 5
2.5 Basic equipment 7
2.6 What plant material to collect 7
2.7 Dealing with collected material in the field 11
2.8 Label information 15
3. PRESSING 20
3.1 Equipment 20
3.2 Aims 20
3.3 The plant press 20
3.4 How to pack a plant press 22
3.5 Methods 22
3.6 Special treatments 25
4. DRYING 31
4.1 Equipment 31
4.2 Method 31
5. MOUNTING 33
5.1 Main aims 33
5.2 Equipment and materials 33
5.3 Résumé of procedures 35
5.4 Selecting material 37
5.5 Placing plant material on the mounting board 37
5.6 Methods for attaching specimens 38
5.7 How to mount labels 39
5.8 Paper envelopes or capsules 40
5.9 Number or jeweller's tag 41
5.10 Duplicates 41
5.11 Remounting and repairing 43
5.12 Handling bryophytes 43
6. PRESSING AND MOUNTING AQUATIC PLANTS 45
6.1 Why special techniques? 45
6.2 Emergent plants 45
6.3 Floating attached plants 47
6.4 Submerged plants 48
6.5 Free-floating plants 48
7. SELECTED PLANT GROUPS 49
8. FIELD HERBARIUM 52
9. HEALTH AND SAFETY HINTS FOR COLLECTORS 53
10. FURTHER READING 55
ACKNOWLEDGEMENTS 57

Digitized by the Internet Archive
in 2016

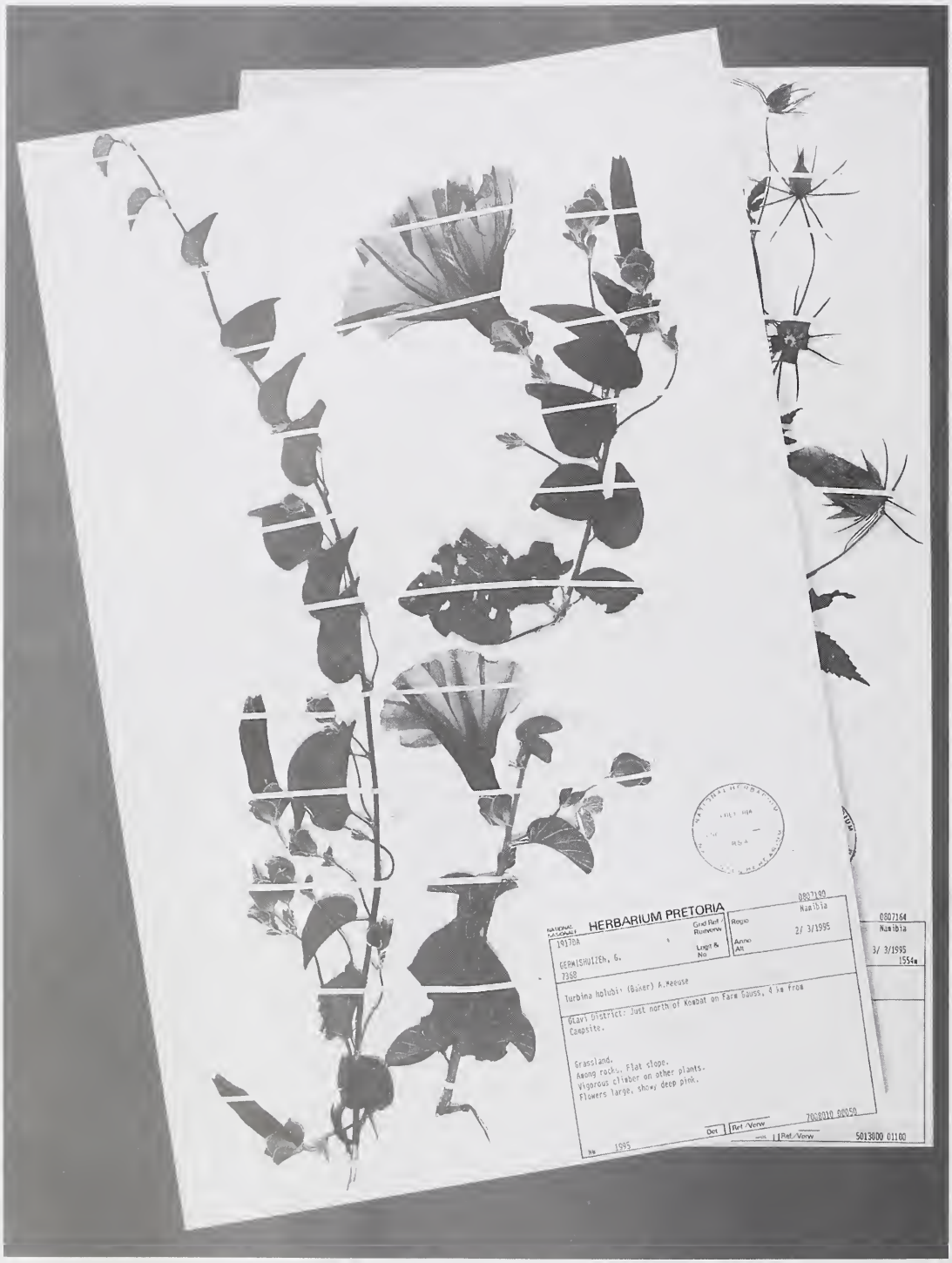
https://archive.org/details/preparingherbari07fish

ABSTRACT

FISH, L. 1998. Preparing herbarium specimens. *Strelitzia* 7, 57 pp.

Keywords: collecting, drying, herbarium specimens, mounting, pressing

Herbarium specimens are resources that can provide a large amount of information, both on the taxa represented and on the flora and vegetation of a region. In the light of the cost, effort and time involved in establishing and maintaining a herbarium, specimens should be prepared in such a way that they would serve their purpose for hundreds of years. Techniques that will enable present and future users to obtain the maximum from specimens in a herbarium collection, are described. Plant material collected should include as many characters of a plant as possible. Specimens should then be pressed in such a way that all or most of the characters will show. Careful drying of the pressed material ensures that specimens remain intact. It is essential for collectors to provide comprehensive label information covering especially those aspects not obtainable from the pressed material but nevertheless important to the knowledge of the taxon concerned and the vegetation of the region. Mounting specimens properly makes them easily accessible for study and prevents damage when they are handled and stored.


HERBARIUM PRETORIA
0807199
Namibia
Grid Ref/ Rutering
19J7Da
Legit & No.
Regio
2/ 3/1995
Anno
An
GERMISHUIZEN, G.
7360
Turbina holubii (Baker) A.Meeuse
Olavi District: Just north of Kowbat on Farm Gauss, 4 km from Campsite.
Grassland.
Among rock. Flat slope.
Vigorous climber on other plants.
Flowers large, show deep pink.
Det
Ref/Verw
19
95
7008010 00050
5013800 01100
0807164
Namibia
3/ 3/1995
1554m

1 Introduction

1.1 Aim of the book

This book is aimed at the many students who at one time or another have to prepare herbarium specimens as part of their course; at professionals who at some stage of their careers have to submit plants for identification and find that their specimens are unacceptable to the herbarium they approach; at landowners interested in establishing their own reference herbarium of the plants on their property; and at amateurs who would like to make a contribution to our knowledge of the environment by helping to make an inventory of the flora and who often live too far from a reputable herbarium where they can find help. It will also be useful to those just starting their careers at a herbarium or to anyone who has to begin a new herbarium. Some requirements mentioned in the book may not be relevant to all these parties, for example the use of archival adhesives, but the basic procedures are the same, whatever one's reason for preparing herbarium specimens.

For accurate identification, there are certain characters of the plant that have to be clearly represented by the specimen and it is therefore important to know what and how to collect. It is necessary to know how to press and dry plant specimens properly since actual identification is often done some time after the plants have been collected. Herbaria usually do not have sufficient staff or funds to build up collections entirely on their own and then depend on material contributed by outsiders for a large part of their holdings. For a specimen to be incorporated into such a collection, it must comply with certain standards since the quality of the specimen and the details on the label determine the amount of information obtainable from it. Although much has been written on the preparation of herbarium specimens, it is often hidden in books also dealing with the many other aspects of herbarium-keeping or in journals not easily accessible to everybody—therefore this book dealing only with the collecting, pressing, drying and mounting of specimens.

Drawings rather than photographs were used since it is easier to emphasise certain points on a drawing than to find the perfect herbarium specimen to photograph showing everything one wishes to illustrate. A single drawing can be used to show many different features, thus cutting down on the number of illustrations and amount of space. Furthermore, the drawings have been kept as simple as possible, with emphasis on the salient points.

The chapter on mounting was included for all those who have to make permanent specimens. When specimens are mounted for long-term preservation such as for most reputable herbaria, archival mounting board and an adhesive such as methyl cellulose is recommended. However, curation of a collection and care of mounted specimens, such as insect control, fall outside the scope of this book.

In the chapter on health and safety, no symptoms, treatments or procedures for dealing with problems are given. The aim is to make the reader aware of the main health and safety aspects that may be encountered on collecting trips. Readers should consult a medical practitioner, first-aid organisation or literature on the subject for up-to-date information.

1.2 Herbarium: what and why

A herbarium is a special type of museum and data bank. It is basically a storehouse of valuable information in the form of scientific botanical specimens.

A herbarium houses a collection of plant specimens prepared for scientific study and is often built up over a long period of time. The specimens have been pressed, dried and mounted on standard-sized sheets of thin, white cardboard and then labelled and placed in folders. These folders are filed flat in upright filing cabinets with compartments to fit a convenient number of specimens. Several to many specimens of the same species collected at different times and in different parts of the distribution area are preserved. This results in comprehensive distribution records and evidence of the range of morphological variation within species.

A herbarium collection is used as reference material for identification, by matching unnamed plants with named specimens in the collection. Identifications can be important to such people as seed dealers, farmers, legal experts, medical practitioners, veterinary scientists, entomologists dealing with plant-eating insects, those involved with control of plant invaders either by biological control or herbicides, plant pathologists, horticulturists, landscapers and conservationists.

Herbaria are repositories for voucher specimens, which are the specimens of material on which scientific work has been conducted. Classification systems are constantly being improved, often resulting in different circumscriptions of taxa and alteration in the application of names. Without voucher specimens, the work can become dated and the validity of the work can be questionable.

The comprehensive herbarium is an essential working tool for taxonomists for their taxonomic, phytogeographic and morphological studies. Taxonomists' ability to answer many taxonomic questions depends to a large extent on the *quality* and *completeness* of the representation of the relevant plant or plant group in the herbarium.

Other information that can be extracted or compiled from a herbarium collection includes:

- Distribution maps. The distribution of a species can be plotted on a map by marking the points where specimens of the species have been collected.
- Flowering and fruiting times. This can be determined by listing the months in which flowering or fruiting specimens of a certain species have been collected and then compiling a histogram. This information can, for example, be used to determine the best time for general collecting in an area or for finding fertile material of a certain species for a research project.
- Characters of a plant. Descriptions of species can be done from herbarium specimens by measuring structures, counting components and observing shapes.
- Floras and checklists. A survey of the plants in an area can be made by listing all species of which specimens have been collected in that area.

1.3 Importance of making good herbarium specimens

Correct collecting, pressing, drying and mounting of specimens and good labels are basic for a well-preserved, comprehensive, scientifically informative herbarium. There are a number of reasons for this:

- Properly prepared, mounted and well-curated herbarium specimens can survive for hundreds of years and are therefore available for research throughout this time.
- Proper identification depends on specific characters of plants, and if these are not represented in the collection, the identification of plants can be nothing better than calculated guesswork.
- Sterile or incomplete material usually cannot be accurately identified and adds little information about inflorescences, flowers or fruits, and is therefore of little or no scientific value.
- Taxonomic studies cannot be conclusive with incomplete specimens.
- Space in the herbarium is often a primary consideration and therefore specimens cannot be incorporated indiscriminately.

- Poorly pressed material is often bulky, taking up much unnecessary space in herbarium cupboards, it is difficult to mount, it is often more susceptible to damage, and many of the important characters of the plant may be hidden.
- Severe damage can cause a specimen to lose its scientific value. Therefore specimens being pressed must dry out as quickly as possible to prevent fungal growth or loss of flowers and leaves which tend to fall off if the material is dried too slowly.
- A specimen without the basic label information is of no scientific value and cannot be incorporated in the herbarium collection.
- Proper mounting is necessary to protect dried plant specimens, which are easily damaged.
- In the herbarium, specimens are filed and stored in cupboards, but proper mounting allows for easy access, without damage to the valuable material.

The quality of the specimens and label information filed in the herbarium determines the value and the amount of information available for future reference.

2 Collecting

2.1 Planning

There are many reasons for collecting, but it is best to do it in liaison with a reputable herbarium. It is important to plan carefully when and where to collect. Especially if the aim is floristic collecting (see below), careful planning is necessary to avoid collecting in well-collected areas while under-collected areas remain neglected (see *Amateur collectors* on page 5 for more information). Proper planning not only saves the environment from indiscriminate removal of plants, but also prevents the processing and storage of unnecessary material in herbaria, which are often understaffed and where space is always at a premium.

2.2 Type of collecting

Taxonomic purposes

This type of collecting is usually part of specific research projects, concentrates on specific plant groups and is usually confined to plants within a specific family, genus or species. Voucher specimens for cytological or anatomical projects also fall into this category. It is important to prepare voucher specimens of good quality and deposit them in a reputable herbarium to ensure that the identity of the subject of the research can always be verified.

Floristic collecting

This entails collecting of all plant species in a certain area, often in regions poorly represented in a specific herbarium, or in areas where an unusual event has occurred, for example fire after many years or unusually heavy rains, or in an area of specific interest, for example a nature reserve or specific geological formation.

Identification

This involves the collecting of plants or plant species for which a name is needed to carry out a specific project, for example the food source of insects, weeds for herbicide trials, possible species for introduction into gardens, or environmental impact studies.

2.3 Who collects plant material for preparation of herbarium specimens?

Herbarium staff

Much of the material housed in a herbarium is usually collected by its staff, taxonomic and floristic collecting being the two main types of undertaken by staff.

Nonherbarium staff

The role played by outside collectors is of the greatest importance in the development of a herbarium. Possibly owing to budget constraints and the extensive geographical region that often has to be covered, the staff at a herbarium cannot collect with the intensity needed for excellent coverage of a particular floral area. To be cost-effective, herbarium staff furthermore tend to collect only during a prime season (after good rains) or when the most species are known to be flowering. Main outside collectors are:

Professionals

They work at institutions, for example universities, technikons or research organisations, in fields related to plant taxonomy such as nature conservation, landscaping, ecological survey or weed control. Some of these institutions may have their own herbaria or rely on national or provincial herbaria.

Students

Many educational institutions require their students to collect, press, dry and mount a number of plant specimens for some of the courses. These specimens often form the backbone of a teaching or reference collection while the excess can be housed in the institution's own herbarium or in a reputable herbarium in the area.

Amateur collectors

These collectors can be very effective as they often tend to collect in close proximity of their homes and throughout the year. This means that they can collect species that flower after events such as fires or unusual weather patterns in their area and during the season when most plants are dormant. They often have more opportunities than professionals to collect rare and interesting plants and furthermore, to make a comprehensive record of the flora in their chosen area.

Amateur collectors should work through a reputable herbarium. Today the collections of many herbaria are computerised, making it easy to obtain information on under-collected areas or groups of plants not well represented in the herbarium.

All collectors should be encouraged and trained to collect and prepare plant specimens of good quality accompanied by properly completed labels so as to obtain the maximum scientific information from each collection.

2.4 Restrictions on collecting

South Africa and many other countries are signatories to the International Convention on Biological Diversity. To protect indigenous flora against widespread and indiscriminate collecting, it has become necessary for strict control on the collecting of plants. It is advisable to be aware of the laws applicable in a certain area before collecting and to obtain the necessary permits. The ordinances or requirements for permits may vary from country to country or in the different provinces of a country. Permits are usually obtainable from the different nature conservation or government departments in charge of the environment or indigenous plant control.

In South Africa, permits are needed even for unprotected taxa, while special permission is required for threatened and protected taxa.

Collecting permits

As a general rule it can be stated that:

- No plant may be collected or transported without a collecting permit.
- In addition to the permit, written consent of the landowner or his or her proxy is needed before a plant may be collected.
- No collecting may be undertaken within a distance of 90 m from the centre of a road.
- General collecting permits do not automatically allow for the collecting in provincial nature reserves or national parks.
- Permits are usually not obtainable from herbaria.
- Permits are usually obtainable from government departments in charge of the environment or indigenous plant control.
- It is advisable to apply for a permit well in advance, as it may take several months to process.
- Forestry areas and nature/game reserves usually require their own collecting permits. Even with the necessary permit, prior arrangements must still be made with the local officers responsible for the area in which the collecting is to be undertaken.

Special permits

- *Phytosanitary permits* may be needed when transporting plants across borders of some

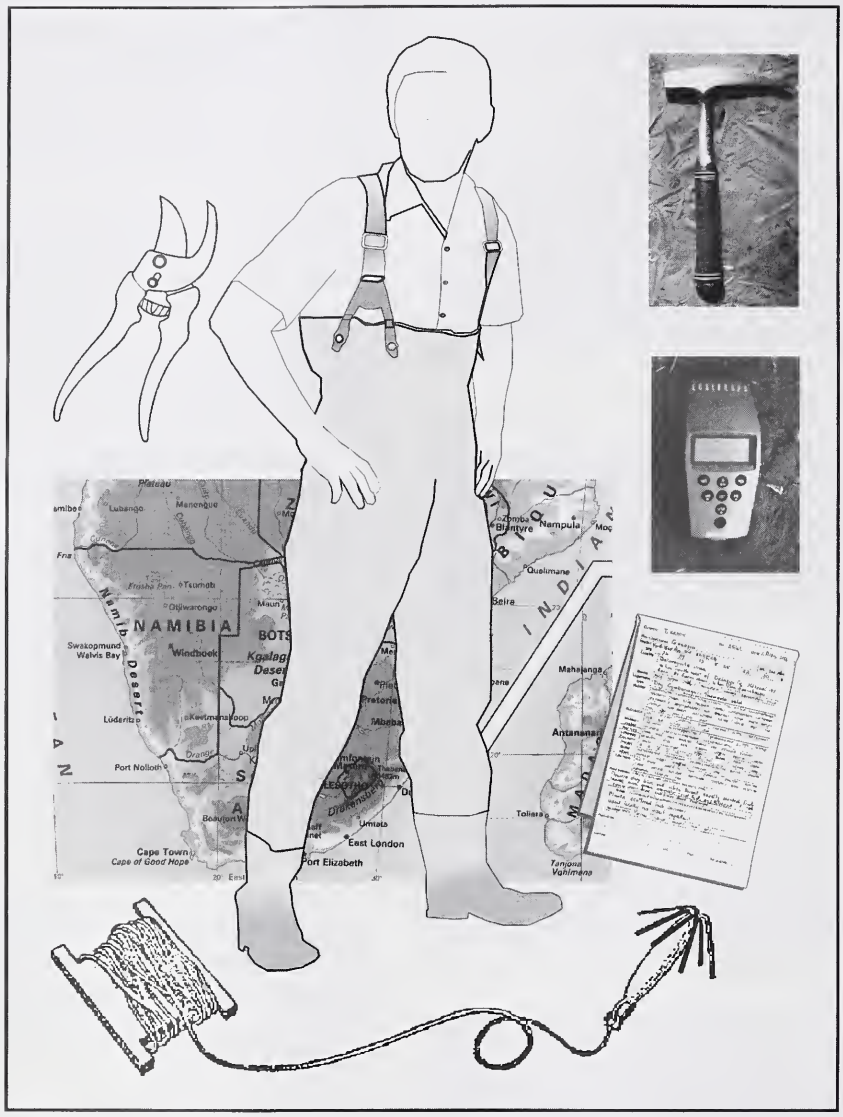


FIGURE 1.—Some of the equipment used for collecting: map, GPS instrument, booklet with tear-out field labels, prospecting hammer, secateurs, waders and aquatic plant rake. Graphic design: S. Turck.

countries (South Africa is one of them), and must be obtained from the country of origin.

- *CITES*: Convention on International Trade in Endangered Species. Among other things, this legislation regulates and controls the international trade in material obtained from plants considered to be endangered. Scientific material is not exempted from it. For the movement of CITES-listed material, a CITES export permit from the source country and a CITES import permit from the relevant conservation authority are needed.

2.5 **Basic equipment** (Figure 1)

- Digging equipment: prospecting or geological hammer, small hand spade or hand-pick.
- Cutting equipment: secateurs and/or pruners (with an expandable pole for very tall trees) for collecting specimens from large, tall or woody plants such as shrubs and trees.
- Small knife for lifting bryophytes off their substrate.
- Waders and aquatic plant rake.
- Plastic bags:
  - Small size (± 270 × 500 mm) in which to place each individual collection.
  - Large bag (± 550 × 850 mm) in which to place all the smaller bags. Large heavy-duty fertiliser bags work well.
- Day or field press if the collector prefers to collect straight into it instead of into plastic bags.
- Brown paper bags of different sizes for seeds and/or fruits, bulbs, succulents and bryophytes.
- Shoulder bag for bryophyte collections or any small delicate collections.
- Tissue paper and newspaper for bryophytes.
- Notebook, collector's register or printed herbarium field labels (for recording details that will not be visible on the dried specimen but are needed for label information).
- Pencil or waterproof pen so that the writing can withstand moisture.
- Lens of 10 × magnification.
- Topographical, geological and vegetation maps of the area concerned.
- GPS (Global Positioning System) instrument.
- Number or jeweller's tags, about 30 × 20 mm.

2.6 **What plant material to collect**

If one wishes to have accurate identifications or is serious about adding valuable specimens to a herbarium collection, the importance of collecting good plant specimens cannot be over-emphasised.

- The general rule is to collect only plants in flower or fruit (both if possible), as most often the characters traditionally used for identification in the herbarium are found in these organs.
- A good collection comprises all the organs, i.e. underground parts, stems, leaves, flowers and fruits.
- Basal parts of grasses, sedges, ferns and bulbous plants must be included (Figure 2).
- Where possible, collect the entire plant (Figure 3).
- Trees, shrubs and large herbs: only representative parts are collected (Figure 4).
- The identification of many plant groups depends on characters other than only flowers and/or fruits. One has to find out which characters are important for various families or genera. Some groups and the characters concerned are listed in Chapter 7 (page 49).
- Make specimens large enough to present a fair sample of the plant, its manner of growth, branching etc. (Figures 3 and 4).
- Collect enough parts of the same plant to show all the different stages present, for example buds, mature flowers and/or fruits, so that the morphology and other features of the whole plant can best be represented and recorded in the herbarium. Show the complete range of variation that is present (Figure 3).

FIGURE 2.—Basal parts of a sedge should be included in the specimen. The same applies to grasses, ferns and bulbous plants. Artist: G. Condy.

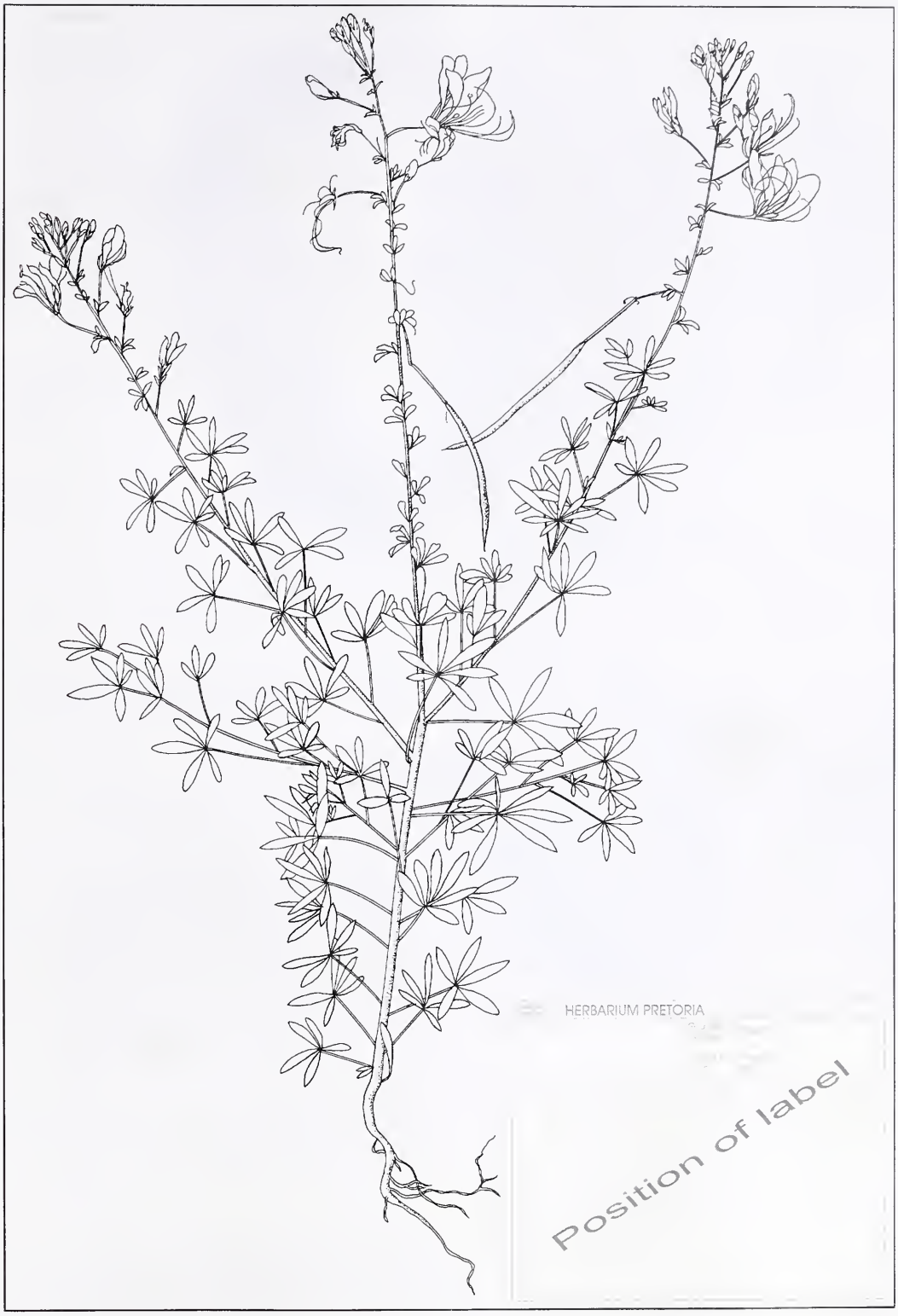


FIGURE 3.—Example of a good specimen: entire plant with roots, stems, leaves, and flowers and fruit in various stages of development. Artist: G. Condy.

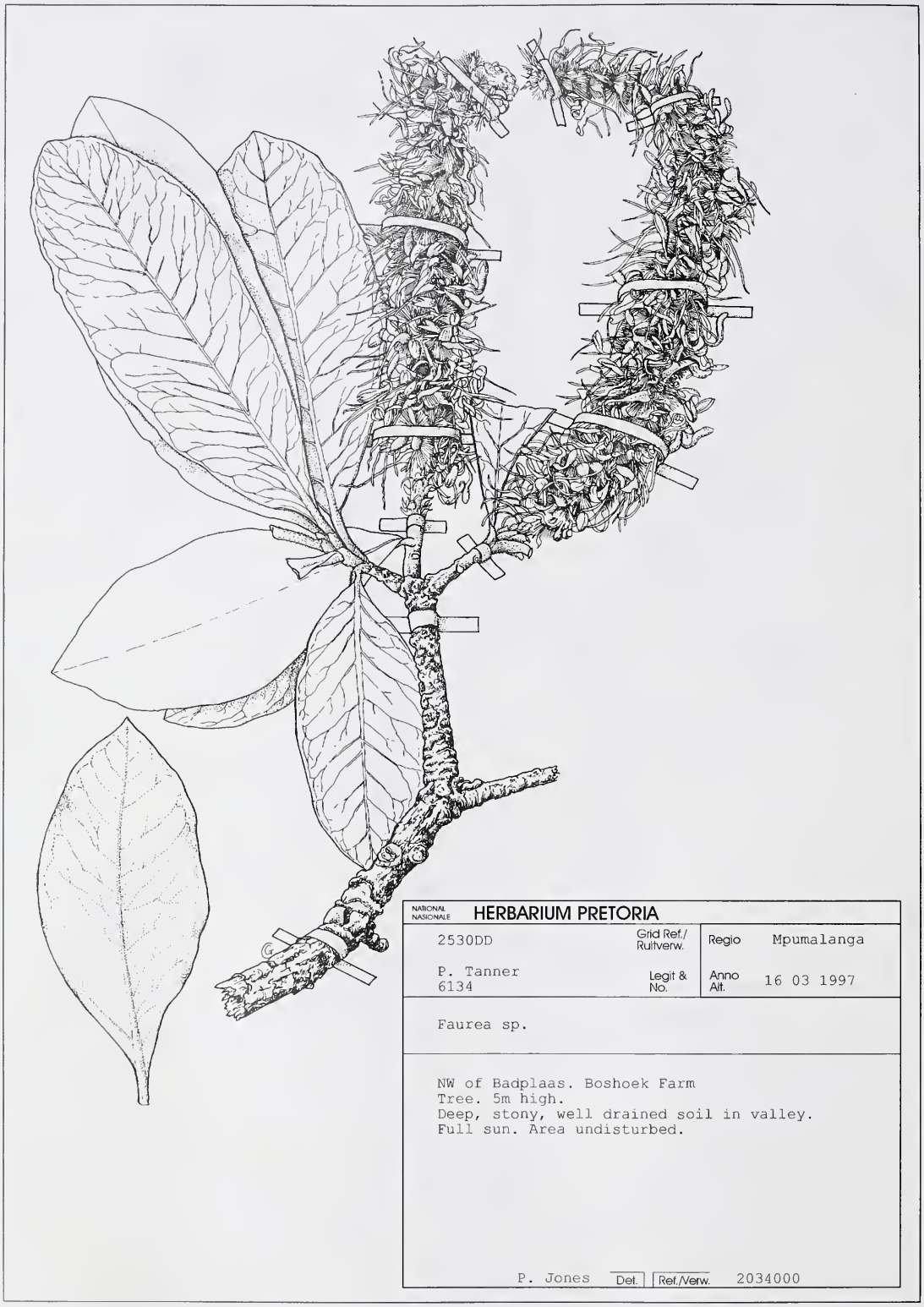


FIGURE 4.—Representative parts are collected in the case of large plants such as trees. The specimen shows leaves and flowers and is large enough to show the manner of branching. It has been pressed to show both leaf surfaces. A leaf has been cut away to expose the inflorescence. Artist: G. Condy.

- Specimens too large for the herbarium mounting sheet can be bent, broken or cut before they are pressed (Figure 5), or only representative parts can be taken.
- Large or complex parts, such as fern fronds or cycad leaves are collected only in part. The base, middle and apex are usually adequate for most taxa (Figure 6).
- Collect lower as well as upper leaves, especially if they differ. If they are available, include coppice shoots as well as material from the canopy.
- Collect both fertile and sterile parts if they differ from one another.
- Many plants develop leaves and flowers at different times. Each separate stage can be collected and pressed as it appears, but great care must be taken to collect them from the same plant (but under different collector's numbers). Large plants such as trees and shrubs are generally marked in some way, while smaller plants are often removed and cultivated in a pot.
- Valuable information can be obtained by collecting the same species in different habitats, at different localities and in different seasons (under different collector's numbers).
- If possible, collect immature as well as mature material:
  - It is helpful to the herbarium identifier who sometimes receives immature material for naming.
  - The taxonomist needs as complete a picture of the development as possible.
  - Immature material is less likely to drop leaves, flowers or fruits when pressed and dried.
- If possible, a number of plants should be collected to show the morphological variation within the population (size, for example) (Figure 7).
- Do not collect only the smallest individuals of a species merely because they will fit on a herbarium sheet or dry easily. Select individuals of average size.
- Adequate samples of the specimen should be collected to fill a herbarium sheet (Figure 7); extra flowers are often particularly useful.
- Collect a number of duplicates as they provide material for exchange or gifts to other herbaria and ensure that collections are not lost entirely should a sheet be mislaid or damaged in one herbarium. This is especially important if a collection is later designated as a type specimen. Duplicates could also be used to build up one's own reference collection, which many field workers or those involved in disciplines related to plant systematics find very useful.
- Do not always be deterred from gathering what appears to be material belonging to a species already collected; it may prove to be different from the one with which you initially associate it.
- Weeds should be collected as information gained from such material, for example distribution records, possible introduction data and rate of invasion, could help with control.
- Bryophytes (liverworts and mosses): see page 27.

Although entire plants and duplicates should be collected, discretion must be used, especially if the plant appears to be rare. Where possible, collect at least one complete plant specimen to show the basal parts and roots, and one duplicate specimen which can be deposited in another herbarium. Should anything happen to the first specimen, a duplicate is available elsewhere.

2.7 Dealing with collected material in the field

Having obtained suitable material, the collector's next task is to deal with the specimens from the point of collection to the stage where they are placed in a permanent press. The ideal is to press material in the permanent press—immediately.

Plastic bags

If there is insufficient time to press the specimens in the field or if the collecting site is too

FIGURE 5.—When this specimen was prepared for pressing, it was bent with the size of a herbarium mounting board in mind and the inflorescence was spread out to show all the parts. Artist: G. Condy.

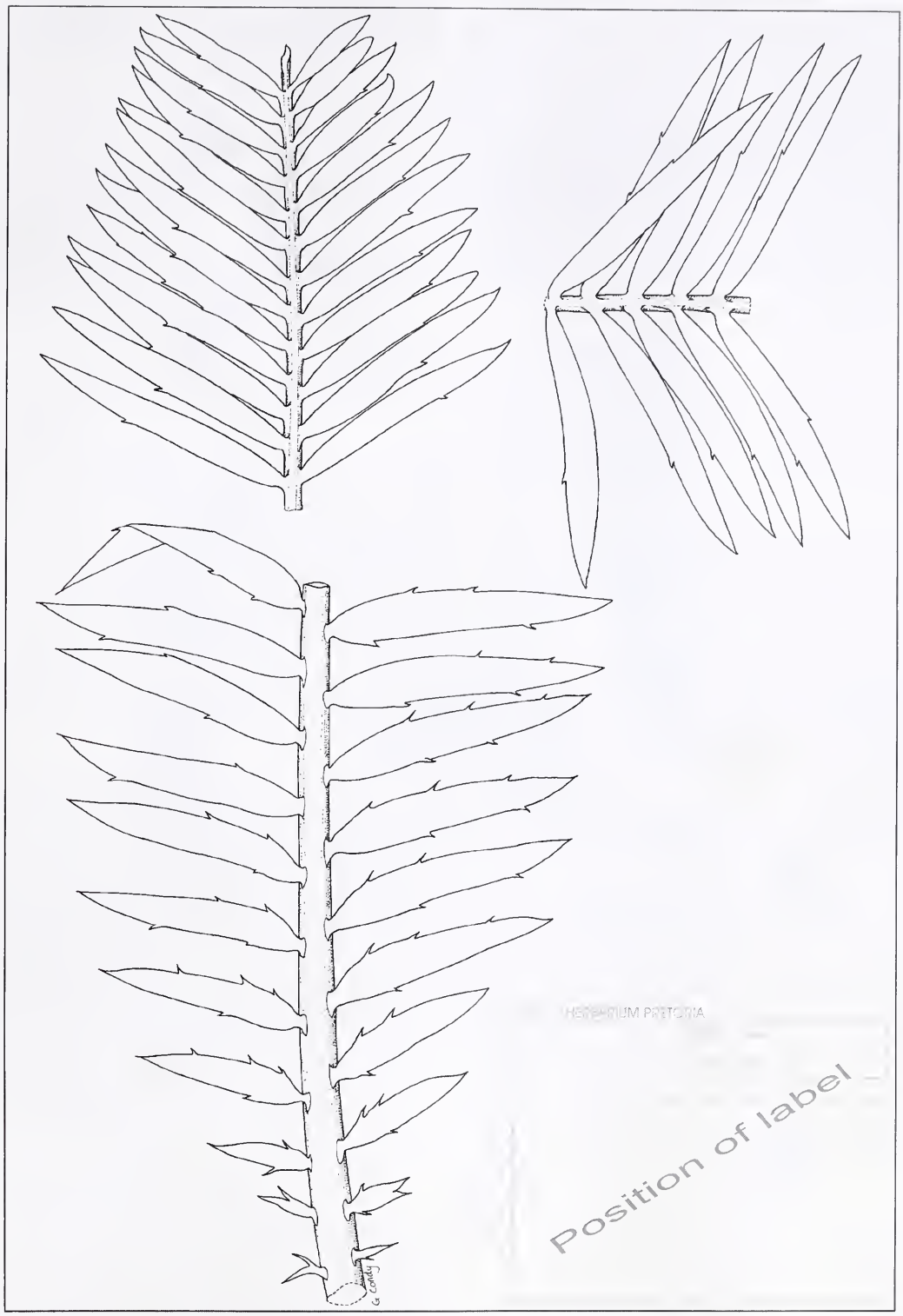


FIGURE 6.—Only the apex, middle and base of large complex parts such as cycad leaves have to be collected. If they are too large for a single mounting board, they can be pressed in separate flimsies and then mounted separately as Sheets I, II, III etc. of the same collection. In this example the parts fit on one sheet. Artist: G. Condy.

FIGURE 7.—Sometimes it is advisable to collect a number of plants to show the range of variation of size, for example. The plants are aligned and mounted in the same direction. Enough plants to fill the mounting board should be collected. Artist: G. Condy.

inaccessible to take presses, use plastic bags. *Remember: the shorter the delay before pressing, the better.*

- Specimens are placed in plastic bags and pressed later.
- Do not use this method for specimens that wilt easily.
- Place each species or separate collection in a small plastic bag, add a few drops of water if possible, and close tightly.
- If number or jeweller's tags (see 5.9) with the collector's name and number are used, attach them to the specimens before closing the bag.
- The small bags are then placed in a single large plastic bag.
- Placing each collection in a separate bag saves time when pressing, there is less damage to the specimens, and flowers or fruits that may have dropped off, are preserved. Therefore, even if plants are too large for the small bags to close, still collect into separate bags.

Field or temporary press

A temporary press is ideal for plants that wilt easily or are too delicate to be placed in plastic bags. There are a number of designs and sizes to choose from. Basically it is a lightweight plant press with flimsies (see page 21) and a few cardboards between them, closed by expandable straps and some device for carrying it around easily in the field (the shoulder bag concept works very well). Some collectors prefer to collect directly into a temporary press and do not use plastic bags.

2.8 **Label information**

The details on the label must be meaningful not only to the collector, but must be clear and unambiguous to anyone who has to gain information from it. Specimens are often sent on loan or as duplicates to researchers in other parts of the world. Well-preserved specimens almost always out-live their collectors and can be of use to many future generations.

The information recorded on the label is as important as the quality of the specimen. Apart from the collector's name and number and the locality, most of the label information concerns those aspects of the plant and its habitat that will not be visible on the dried specimen.

Do's and don'ts

- Record all information that will not appear on the dried specimen itself, such as habit, habitat and all those features that disappear with drying, like flower colour or smell.
- All notes about the plants should be made in the field when the specimen is actually collected (or as soon as possible afterwards), not at a later date.
- Always give precise locality information. Localities should be given so accurately that they can be easily found on available maps and any collector can return to collect in precisely the same place or from the same plant.
- Do not use any abbreviations on the label.

Basic label information (Figure 8)

- Collector's name and number.
- Date on which specimen is collected.
- Locality: latitude and longitude to degree, minutes and seconds and, in the *FSA* (*Flora of southern Africa*) region, the quarter-degree grid square or grid degree reference. Include the closest reference point (such as nearest town or well-known landmark) and precise locality as well.
- Descriptive notes concerning the plant and details likely to be lost on drying, for example flower and fruit colour and markings, smell, milky latex and stickiness.
- Information on characteristics not observable from the specimen, for example time of opening or closing of flowers, taste, parasitic host plant and light conditions.

NATIONAL NASIONALE HERBARIUM PRETORIA

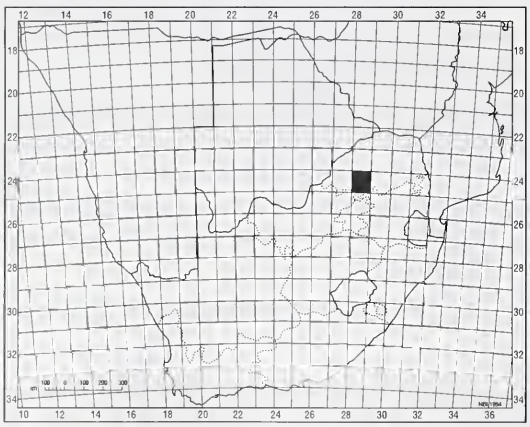
2428 AC	Grid Ref./ Ruitverw.	Regio	Northern Province
S.M. Smith 3015	Legit & No.	Anno Alt.	1/12/1998 1600 m

Plantae magnifique A.Anon.

Waterberg region, ± 47 km west of Nylstroom on road to Vaalwater, farm Kraaifontein 361, on mountain slope near farmhouse.
24°27'59''S 28°14'15'' E
Bushveld. Halfway up gentle mountain slope on rocky sandstone ridge. Growing between rocks in well-drained loamy soil in full sun. Area grazed.
Multistemmed shrub 0.5-1.5 m tall. Bark deep red-brown. Leaves pale shiny green, lemon-scented when crushed. Flowers mauve, upper 2 petals with yellow guidelines. Rare.
VOUCHER FOR ANATOMY.

L. Solomon 1998 Det. Ref./Verw. 890600 3

FIGURE 8.—Example of a standard herbarium label with the basic information.



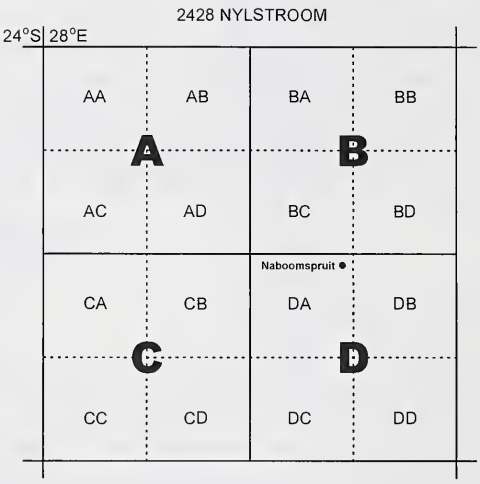


FIGURE 9.—Map of the *Flora of southern Africa* region divided into grid squares. Grid 2428 has been highlighted and enlarged to show how it is divided into quarter degree squares. Graphic design: by S. Turck.

FIGURE 10.—A GPS instrument with which locality can be determined. Latitude and longitude readings are given in degrees, minutes and seconds.

- Aspect, altitude, vegetation type (grassland, forest etc.), geology.
- Life form, size of plant, height, diameter of stem (trees).
- Habitat and biotic factors like soil type and moisture regime (swamp, sand or rocks, open places, shade etc.).
- For bryophytes (mosses and liverworts), the substrate (rock crevice, cliff, boulder, wall, overhang, soil over rock, gravel, sand, loam, clay, tree trunk, branch stump, root, fallen or decaying log, leaf litter, humus, concrete etc.) should be recorded for each specimen.
- Whether frequent or rare.
- Uses and local common names.
- Whether serving as a voucher (e.g. for a painting, drawing, photograph, or seed bank material).

Collector's name and number

- Each specimen collected has a unique collector's number, a collector starting at number 1 for the first specimen collected by him or her, and continuing sequentially from there.
- Make the numbering system as simple as possible. Do not use a system that includes prefixes (JS 134), cryptic notations (Cli:Mon 134) or abbreviations.
- Very small plants collected from the same population are regarded as one collection under the same number.
- Specimens collected from the same plant but at different times must have different numbers.
- Specimens of the same species but collected at different localities must have different numbers.
- All duplicates (i.e. parts of the same gathering) must be given the same collector's number as the original specimen.
- A mixed gathering of taxa mistakenly placed under one number can be separated afterwards by using A and B after the collector's number (1378A).
- Number the specimens by writing the number on a few tags and attaching or tying them to the specimen and its duplicates. Also write the number on the outside of the flimsies in which the specimen and its duplicates are pressed.

Date

This is the date on which a specimen was collected and pressed. It gives valuable information on flowering and/or fruiting times of a taxon and can be used when planning trips to recollect a specimen, to continue research on the population or to collect the taxon in other areas. A brief survey of collecting dates of a few specimens from an area or a specific vegetation type will give a fair idea of the best time to collect in such an area.

Locality data

Accurate localities give important information on distribution. They also enable collectors to return and collect in exactly the same place and even from the same plant, should this be needed for further studies. The nearest town, nature reserve, farm or point of reference to the collecting site, as well as the precise locality, must be recorded for every specimen collected (Figure 8).

- Degree or grid reference system

This system, used mainly in the *FSA* (*Flora of southern Africa*) region, was first put forward for botanical use in 1967 and is largely based on one already in use by zoologists and cartographers for many years.

  - A one-degree square of latitude and longitude is considered as the basic unit of area, often called the grid square.
  - This grid square is known by the degrees of latitude and longitude of the northwestern or top left-hand corner and by the name of a city, town or other important feature in the square, e.g. 2428 Nylstroom.
  - The one-degree square is divided into four half-degree squares (30' × 30'), numbered A, B, C and D from left to right

and top to bottom, and each half-degree square may be subdivided further into quarter-degree squares (15' × 15'), again numbered A, B, C and D (Figure 9).

- For example, Naboomspruit: '2428 (Nylstroom)' is the grid name and '2428DA' is the quarter-degree or grid square or grid reference.

However, currently there is a move away from this system towards a point system of degrees, minutes and seconds obtained from maps or by using GPS readings.

◆ Closest reference point and precise locality

The following are the best ways to obtain this information:

- Maps.

Maps are used to obtain points of reference and precise locality data. The most commonly used ones are the 1:250 000 or 1:50 000 maps, but any other reliable, easily obtainable maps can be used. Maps are usually available from certain government departments or from shops. Longitude and latitude can be determined to a reasonably accurate level from 1:50 000 maps.

- Global Positioning System (GPS)

Although the latitude and longitude of a collecting site can be obtained from a map, a precise locality can be very difficult to describe when there is no direct route to it. GPS instruments (Figure 10) are the latest technology for providing a fairly accurate locality quickly, giving latitude and longitude in degrees, minutes and seconds or in degrees and minutes, the latter with three decimal places. Unfortunately, the satellites with which these instruments operate, give slightly inaccurate readings which may even vary with time. The GPS has many other functions. On plant collecting trips it could, for example, also be used for navigation purposes.

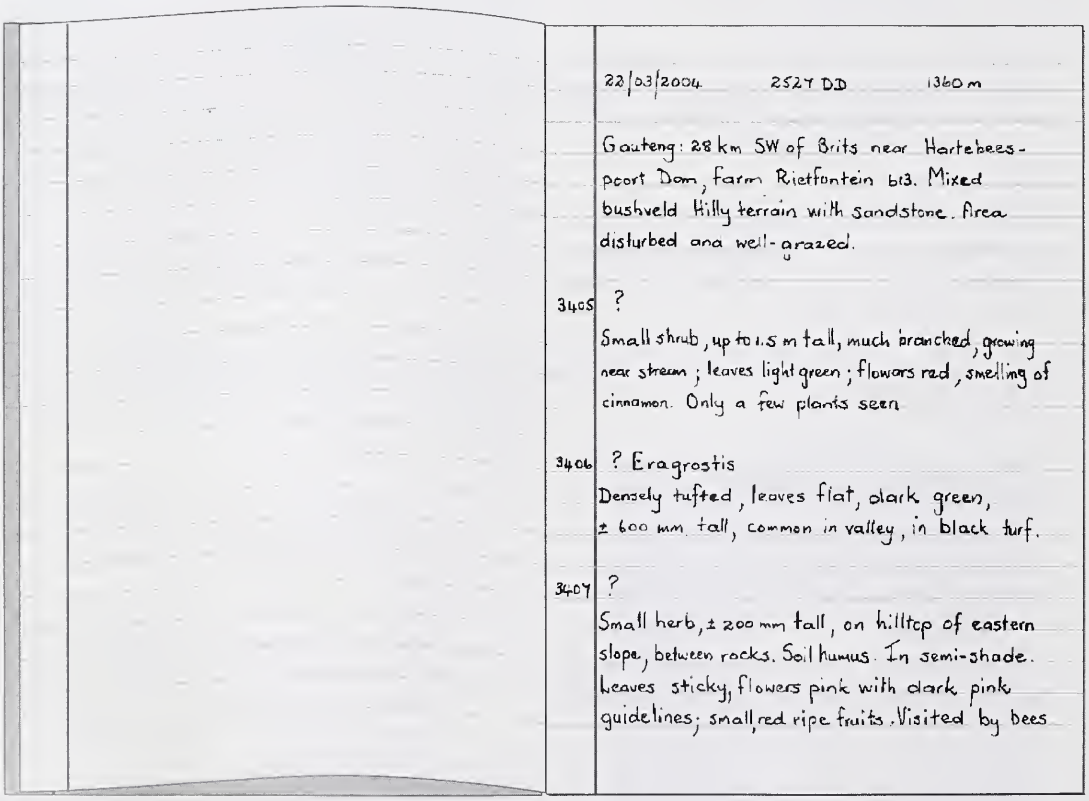

22/03/2004 2527 DD 1360 m
Gauteng: 28 km SW of Brits near Hartebees-poort Dam, farm Rietfontein 613. Mixed bushveld. Hilly terrain with sandstone. Area disturbed and well-grazed.
3405 ?
Small shrub, up to 1.5 m tall, much branched, growing near stream; leaves light green; flowers red, smelling of cinnamon. Only a few plants seen.
3406 ? Eragrostis
Densely tufted, leaves flat, dark green, ± 600 mm tall, common in valley, in black turf.
3407 ?
Small herb, ± 200 mm tall, on hilltop of eastern slope, between rocks. Soil humus. In semi-shade. Leaves sticky, flowers pink with dark pink guidelines; small red ripe fruits. Visited by bees

FIGURE 11.—A page from a collector's register showing how locality details and information on each specimen can be recorded. Graphic design: S. Turck.

Although there is a facility for providing altitude data, this has been found to be very inaccurate and altitude should rather be obtained from a map or by using an altimeter. It is strongly recommended that the GPS should always be used in conjunction with a good, detailed map.

Recording information

There are a number of ways of keeping records of all specimens collected to ensure adequate information on the labels.

- When and how
  - Each record is entered in a field note book or collector's register (Figure 11) or directly onto the specially printed field labels of certain herbaria. These field labels are useful in that each label has most of the basic possibilities already printed on them, making it quick and easy to select the information applicable to the specimen in question (Figure 12).
  - Opinions differ as to when is the best time to record this information, especially since the task is often time-consuming and difficult to perform in the field at the time of collecting. However, it must be done as soon as possible as details can be forgotten or muddled.
  - Hand-written labels should be completed with care to ensure that they are legible for any typist or person not familiar with the terminology. It is best to use a waterproof pen or pencil.
- Collector's register
  - This may be any book the collector uses to make notes about the locality and specimens collected prior to writing labels. It ensures that the collector will retain the original information about the collecting trip and plants collected (Figure 11). The disadvantage is that labels have to be written or typed later.
- Printed herbarium field labels
  - There are many different designs, but basically they lead one to supply the information required. The more detailed ones allow for much of the information to be ticked off directly on the label (Figure 12). The advantage is that although a large amount of information is provided, little writing has to be done in the field or deciphered later. The disadvantage of this method is that unless some provision is made to duplicate or photocopy the labels, the collector does not retain any of the original information about the field trip and the plants collected. Furthermore, unless some sort of coding system is agreed on with a view to the final typing of the labels, the locality and habitat information has to be repeated for every single collection, and this can waste a lot of time.

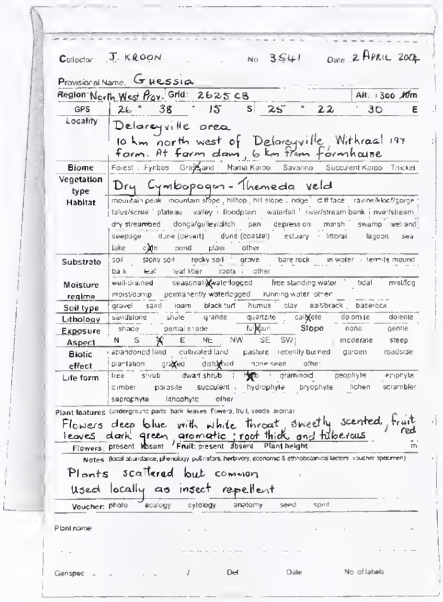

Collector J. KROON No 3541 Date 2 APRIL 200-
Provisional Name Guessia
Region North West Prov. Grid 2625 CB Alt. 1300 m
GPS 24 ° 38 ' 15 " S 25 ° 22 ' 30 " E
Locality Delareyville area
10 km north west of Delareyville Withraai 197
farm. At farm dam, 6 km from farmhouse
Biome Forest Fynbos Grassland Nama Karoo Savanna Succulent Karoo Thicket
Vegetation type Dry Cymbopogon - Themeda veld
Habitat
Substrate
Moisture regime
Soil type
Lithology
Exposure
Aspect
Biotic effect
Life form
Plant features
Flowers deep blue with white throat, sweetly scented, fruit red
leaves dark green, aromatic ; root thick, and tuberous
Flowers present Absent Fruit present Absent Plant height m
Notes
Plants scattered but common
Used locally as insect repellent
Voucher photo ecology cytology anatomy seed spirit
Plant name
Genspec Det Date No. of labels

FIGURE 12.—Printed herbarium field label on which details pertaining to a specimen have been filled in. Graphic design: S. Turck.

3 Pressing

The shorter the time between collecting and pressing, the better.

3.1 Equipment

- Cutting equipment:
  - Secateurs for removing excess plant material before pressing.
  - Small knife or chisel for splitting or cutting parts such as bulbs, corms, seeds and fruits.
- Wax or tissue paper for protecting delicate flowers.
- Gummed paper for dissected flowers.
- Plant presses:
  - Field press or temporary day press used in the field for pressing certain plants immediately.
  - Permanent or main press for pressing specimens until dry.
- Plastic bottles with preserving liquid or fixative.

3.2 Aims

- To dry the plant material as a form of preservation.
- To prevent all parts from wilting.
- To position specimens in such a way that all the different parts are clearly visible.
- To preserve delicate organs without crushing them.
- To flatten the specimens as much as possible because bulky specimens take up a large amount of space.

3.3 The plant press

Principles on which a plant press works

- The plant material gradually loses its moisture to absorbent paper. The absorbent paper is changed regularly or must loose its moisture to the air through good ventilation of the press.
- At the same time the material becomes flattened by the pressure exerted on it by the press on two sides.
- Pressure is needed to compress but not destroy the organs, so that they can be examined afterwards.

When pressing, always keep in mind the size of the mounting board and the position of the main label. Once a plant is dry, it becomes brittle and very difficult to rearrange for mounting purposes without damage. However, it can sometimes be done by soaking dry material in boiling water and repressing it once it has softened.

Five basic components of a plant press (Figure 13)

- Two strong, rigid, wooden or metal lattice frames:

- Slightly larger than 270 × 420 mm, which is the size of the standard herbarium mounting board.
- Ensures even pressure over the whole area.
- Allows air flow through the contents of the press.

◆ Two expandable straps:

- Strong and easy to close, open and tighten (webbing with D- or round rings is suggested).
- As the material loses moisture, the straps must be continuously tightened to ensure that the plants are pressed flat and do not shrivel.

◆ Drying paper:

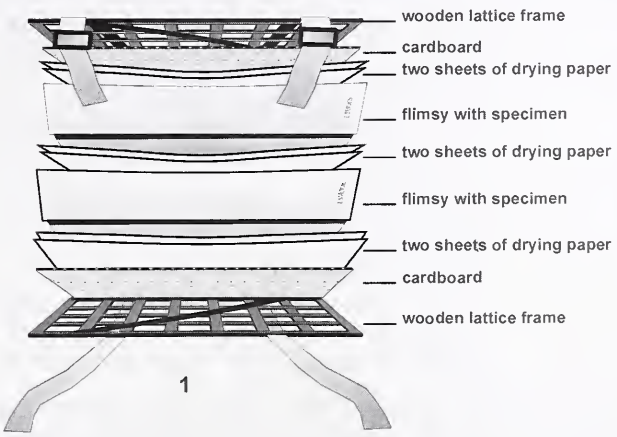
- Paper (280 × 450 mm) with good absorbing properties and slightly larger than the standard mounting board. It is more convenient if these sheets are double since it saves time when pressing or replacing the wet papers with dry ones. Highly absorbent paper is used by professionals, but it can be very expensive. Newspaper cut to size can be used as a substitute.
- Must be regularly changed, especially during the first few days and if the specimen has a high moisture content or the atmosphere is very humid.

◆ Flimsies:

- These should be of thin, strong, slightly absorbent paper. Unprinted newspaper is recommended but printed newspaper can also be used.
- A flimsy is folded from both sides with the opening in the centre to prevent material from slipping out (Figure 14). When folded, it should be the same size as a standard herbarium mounting board (270 × 420 mm).
- The collector's name and number must appear on the outside in the lower right-hand corner (some herbaria prefer it on the upper right-hand corner).
- The plant specimen is placed in the flimsy and retained in it until mounting.

◆ Corrugated cardboards for ventilators or spacers:

- Size: the same size as the drying paper (280 × 450 mm), or slightly larger.
- To allow for air flow to speed up the drying process, the cardboards must have openings or flutes preferably running parallel with their short sides. The problem with cardboard of poor quality is that these openings are easily squashed and that large printed areas reduce its absorbent qualities.



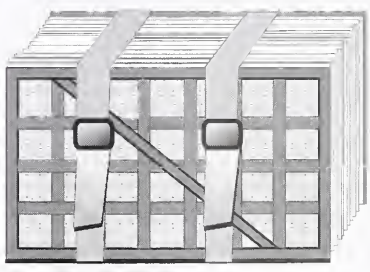


FIGURE 13.—1, plant press opened up to show the sequence of the basic components; 2, plant press, packed and closed. Graphic design: S. Turck.

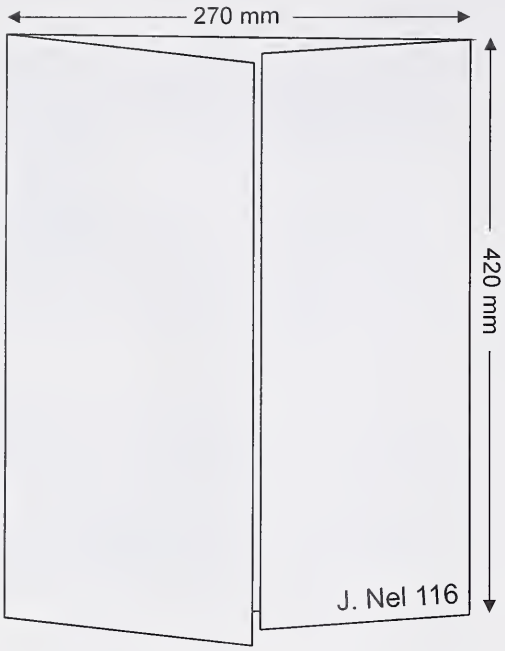


FIGURE 14.—Flimsy folded to open in the centre and with collector's name and number in lower right-hand corner. Graphic design: S. Turck.

- The cardboards separate bulky specimens from more delicate ones which they can damage.
- Corrugated metal sheets can be used instead as they become hot and speed up the drying process, but one should beware of overheating, which can damage the specimens.
- Modern plastic mesh (garden fencing) has also been suggested, but it can be slippery if the press is very thick and it can damage the specimens when it moves about if there is not enough drying papers and flimsies.

3.4 How to pack a plant press

Pack the press in the following sequence: wooden lattice frame, cardboard, two sheets of drying paper, flimsy with specimen, two drying papers, followed by another flimsy with a specimen and so forth, with a cardboard after every five to eight specimens. Finish with the second wooden lattice frame and then pull the straps tight (Figure 13). However, this is only a guideline for the average plant press, as the number of drying sheets and/or cardboards will depend on the moisture content of the plants, the weather conditions and bulkiness of the specimens. In the case of very high atmospheric humidity and/or plants with a very high moisture content, it is best to put a cardboard after every specimen.

3.5 Methods

Correct pressing of specimens is very important because once a specimen has been pressed and dried, its overall shape cannot be altered without some damage.

- Always keep mounting in mind. Remember the size of a standard mounting board (270 × 420 mm), the position of the label and the orientation of the specimen.
- Mud and soil should be removed from roots and other basal parts (e.g. aquatic or marsh plants).
- Spread the specimen out to show all the parts (Figure 5).
- Some flowers should be laid open and others turned over to show both surfaces of the floral leaves. A side view is also useful.
- Ferns should be spread out to show the shape and size of the individual pinnae which can be different on the same frond (Figure 15), especially the basal pinnae.

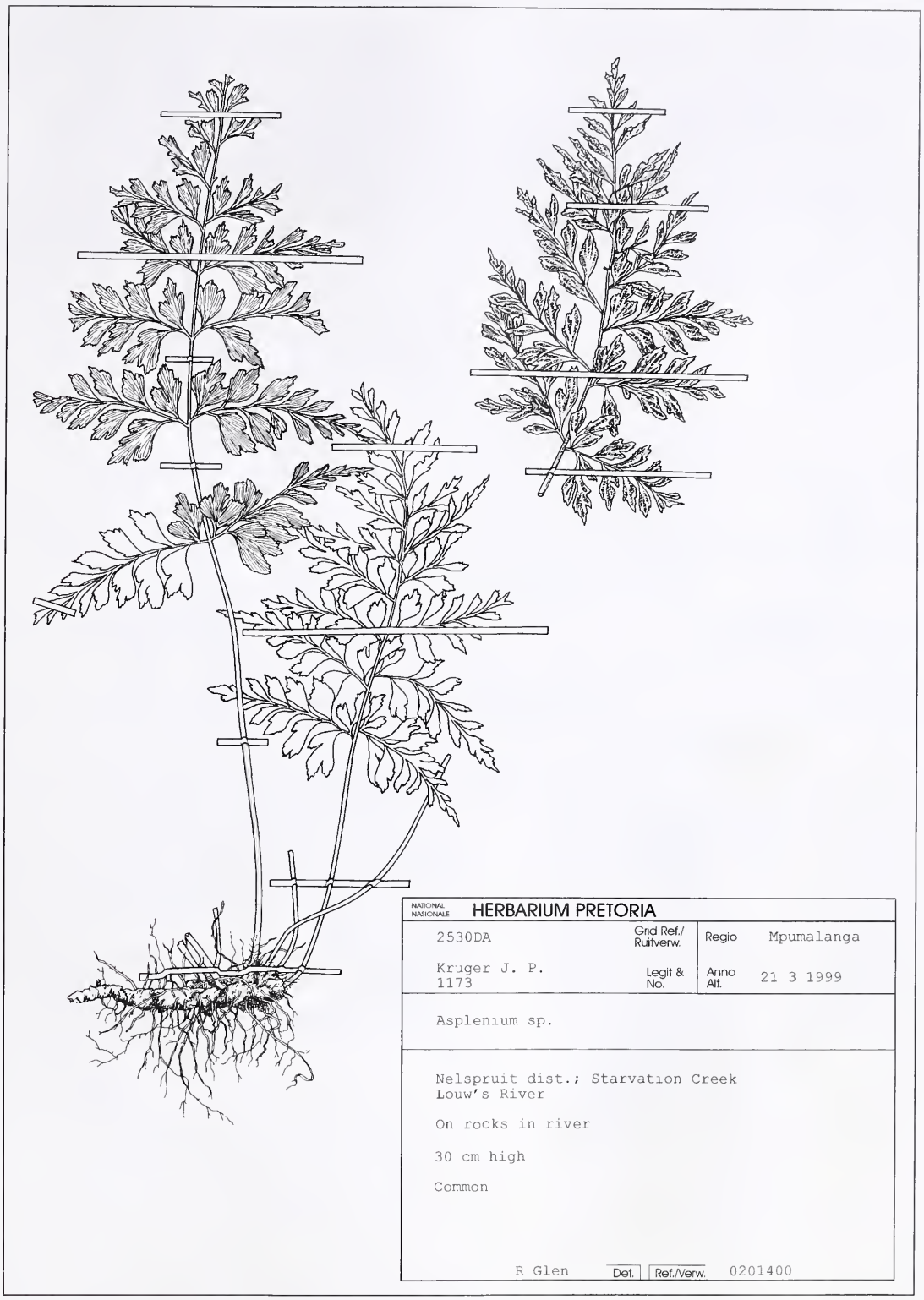


FIGURE 15.—Both fertile and sterile fronds of ferns should be collected if they differ. When a fern specimen is prepared for pressing, the fronds are spread out to show the shape of individual pinnae. The specimen is mounted in such a way that spore-bearing leaf surfaces are also shown. Artist: G. Condy.

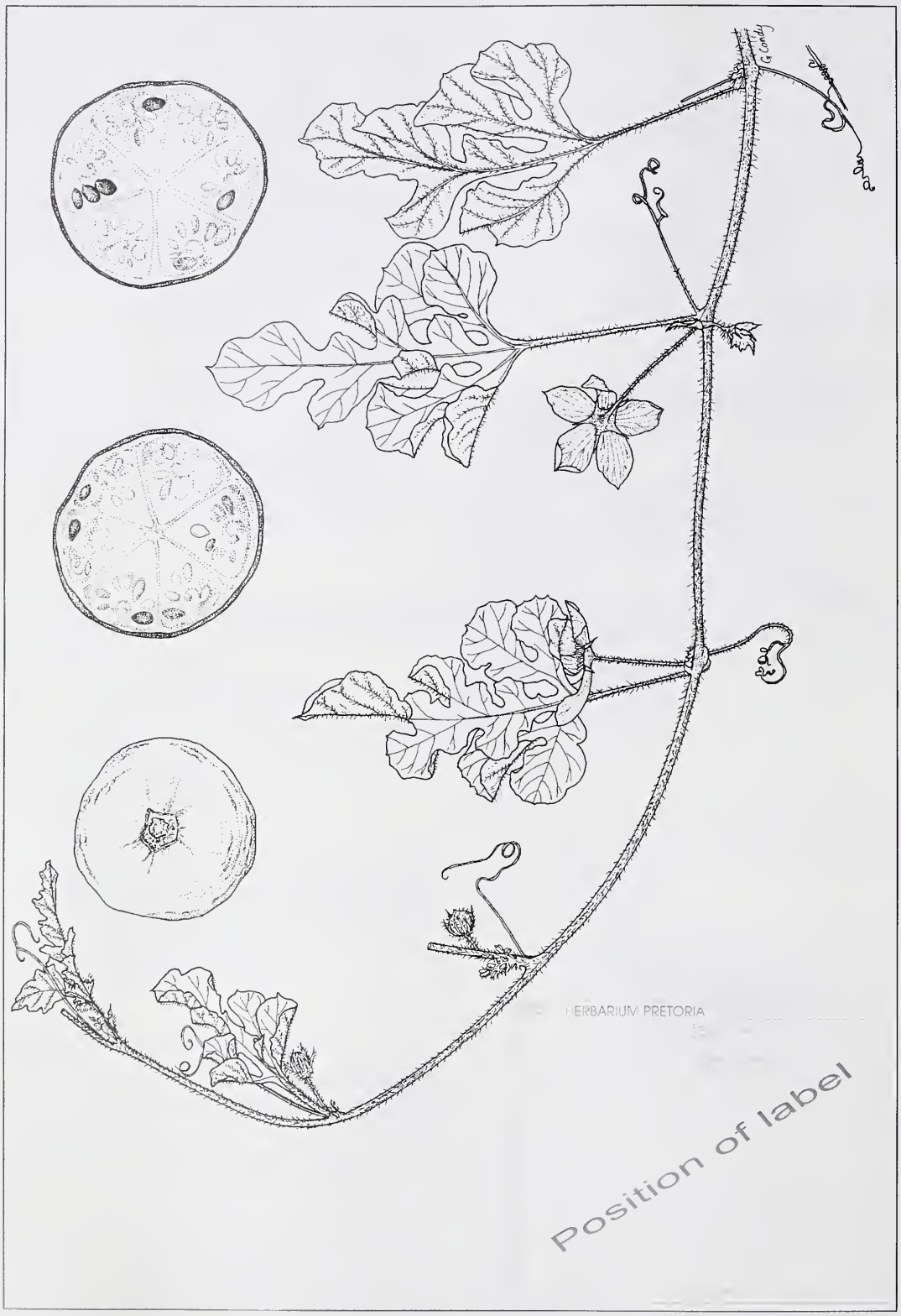


FIGURE 16.—A good collection with flowers at different stages and with bulky fruit cut and sliced into thin sections before being pressed. Some of the sections will be mounted with the specimen. Artist: G. Condy.

- Leaves, especially those of ferns, should show both surfaces (Figures 4 and 15).

- Arrange specimens too large for the herbarium mounting board by bending or breaking them while still fresh, preferably without entirely severing the parts, to fit the board (Figure 5). If cut into different segments, they might become separated and cause much confusion.

- Plant parts too large for standard mounting boards of which only representative pieces are collected, e.g. cycad leaves, should be subdivided (Figure 6). If too large for a single flimsy, each piece is labelled sequentially and pressed in a separate flimsy bearing the collector's name and the same number.

- Large specimens with thick stems, roots or bulbs, and even some flowers and fruits, often have to be split or cut to make them less bulky (Figure 16). This saves space and prevents damage to other specimens in the herbarium cupboard.

- Specimens with some portions much thicker than the rest have to be padded. Absorbent paper is placed over the thin portions, bypassing the thicker portions to even out the pressure within the press and to prevent wilting of the thinner parts (Figure 17). A quicker, but less successful method is to use sheets of foam rubber of the same size as the drying paper.

- Excess leaves or flowers that obscure each other or other organs may be removed, leaving part of the petiole or flower stalk to show that something has been removed (Figure 4).

- With delicate or short-lived flowers it is best to take extra ones and place them in wax or tissue paper and press them separately. Small gummed cards can also be used, especially if the pressed flowers have to be dissected (see *Fragile flowers* on page 27).

- Seeds that would easily get lost should be placed with the specimen in an envelope or capsule with the collector's name and number written on it.

- It is advisable to place the thick parts of specimens alternately at different positions in the flimsies to keep the press even and level and to ensure that all parts, especially thinner ones, are being pressed properly.

- After 12–24 hours in the press, unmanageable specimens can be rearranged in their flimsies as they will still be partially damp but easier to handle.

3.6 **Special treatments**

- Succulent or fleshy plants

  These plants usually have a very high water content, which presents problems on drying. Some also tend to remain alive—even in the press! However, there are a number of techniques to overcome this problem:

  – Plant material can be cut longitudinally and/or transversely, and the fleshy inner tissue can be cut or scraped out and removed before pressing (e.g. leaves of *Aloe* species).

  – Plants can be killed by submerging them in a liquid such as spirits, petrol or even household vinegar (it helps to pierce the material with a needle to allow penetration of the liquid), by placing them in very hot water before pressing, or by freezing them for a few hours or days while still in the press before they are dried in the usual way.

  – Plant material can be placed unpressed in a freezer for two days, then put in a flimsy in a microwave oven at 80% power for 1–5 minutes (depending on the amount of material), and finally dried between drying paper and cardboards in a press or press-dryer (for up to two weeks) (P. Burgoyne, pers. comm.).

  – Flowers can be opened and pressed on ordinary gummed paper (see method under *Free-floating plants* on page 48).

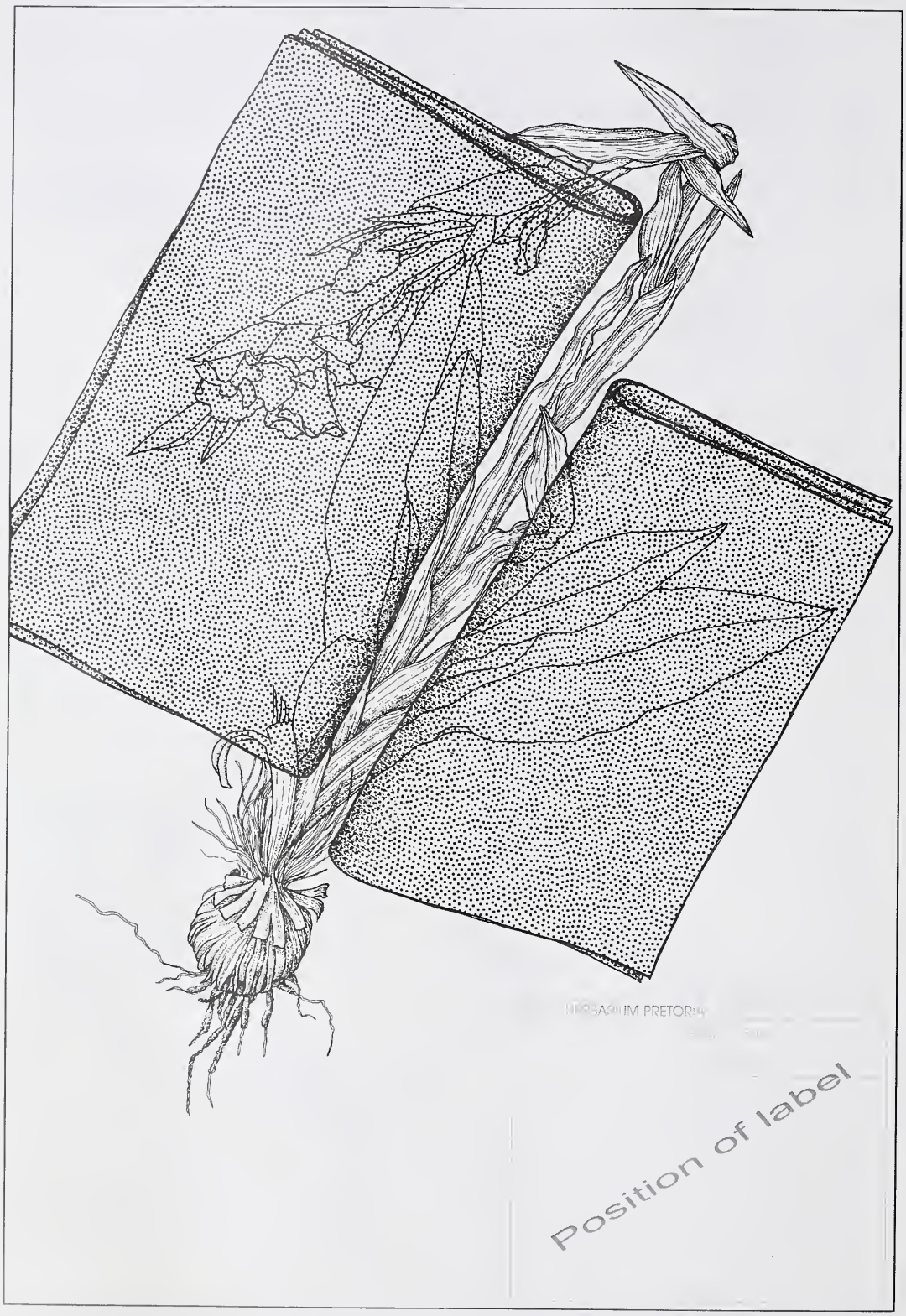


FIGURE 17.—Padding is used to even out different thicknesses, thus ensuring equal pressure on all parts of the specimen in the press. Artist: G. Condy.

- Bulbs, corms and other fleshy underground organs
  - These plant parts should be longitudinally sliced into thinner segments (Figure 18). Methods given in the second point under *Succulent or fleshy plants* above can also be used as these organs also tend to remain alive, sometimes even after they have been cut.

- Spiny plants
  - Long and/or rigid spines and thorns that are protruding along the upper or lower surface of a specimen should be removed if they cannot be bent easily.
  - By placing the spiny specimen in its flimsy in the press with a number of cardboards (enough to prevent thorns from piercing through) underneath and on top and pressing down firmly, it will be possible to bend many of the thorns and the specimen can then be pressed in the usual way.

- Graminoids
  - Bend the stems by bruising them with a fingernail. Do not cut unless absolutely necessary (Figure 19).

- Fragile flowers
  - In some families, the dried flowers are too fragile to rehydrate to enable flower parts to be studied microscopically. Fresh flowers should be dissected and preserved in some way to allow detailed studies later. One method devised by Dr L. Bolus (± 1920) is the use of gummed cards. Cards are covered with gum arabic, allowed to dry and placed in an airtight container until needed. The flowers are dissected and placed on the lightly moistened gummed card, cellophane is placed over the card which is then placed in a mini-press until dried. The card is then mounted with the specimen.
  - Method for making up gum arabic and preparing cards: 4 cups of powdered or granulated gum arabic or gum acacia is dissolved slowly in 2 litres of cold water. The solution is allowed to stand for a day or two, then strained twice through a nylon stocking and bottled for use. The gum is painted onto cardboard such as herbarium mounting board with a paintbrush. A few coats can be painted, allowing it to dry thoroughly after each coat. The board is then cut into cards of suitable size.

- Material in preserving or fixative liquids
  - Parts of plants of some families or certain species often have to be placed in a preserving liquid or fixative. This ensures that the shape of parts and organs important for identification is retained. Such a collection is often referred to as a spirit collection. The type of preservative should be clearly indicated on the airtight glass or plastic jar used. A number of the older preserving liquids have fallen into disuse since they contain formaldehyde, a toxic carcinogenic substance. It is best to contact the nearest herbarium, university or technikon to obtain the latest and best preserving liquid.

- Bryophytes (liverworts and mosses)
  Contributed by J. van Rooy

  The procedures involved in collecting bryophytes (Figure 20) are different from the standard collecting methods but relatively easy, and practically no field preparation is necessary.

  - *Specimens should not be pressed* as this will distort the form of the plants and destroy some of the critical morphological features.
  - A specimen is simply lifted from the substrate by hand or with a knife and carefully slid into a brown paper bag, *not a plastic bag or plastic container, not even for carrying or transporting the specimens.*
  - With a knife or chisel, scrape or peel the plants from the substrate, taking care to include the layer of soil, bark or humus just below the plants. This topmost layer of soil or bark may contain structures of taxonomic importance.
  - Some terrestrial bryophytes, e.g. species of the thallose liverwort genus *Riccia*, are

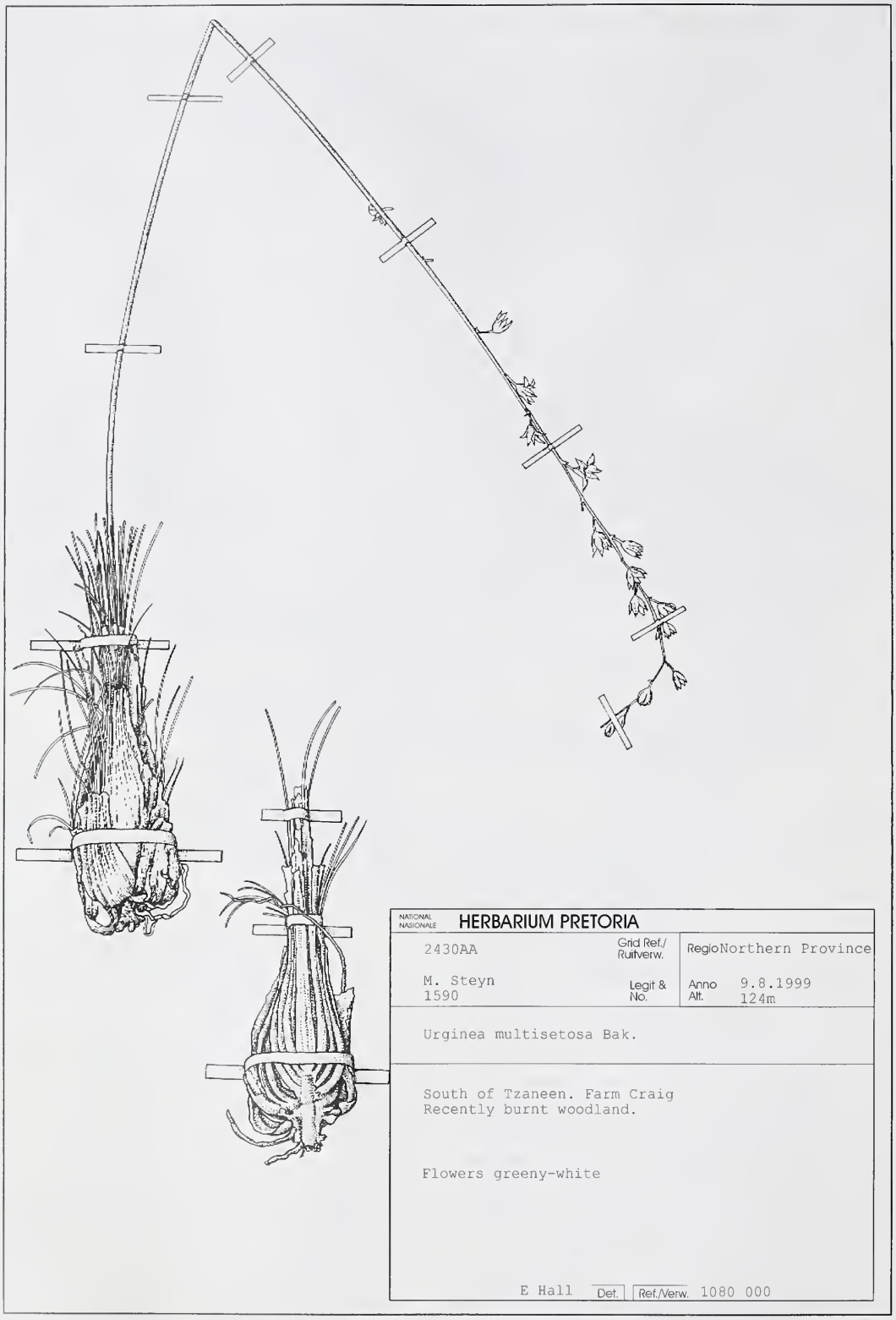


FIGURE 18.—A good collection with flowers, stem and bulb. The bulb has been longitudinally sliced and the cut piece pressed and mounted with the main specimen. Artist: G. Condy.

FIGURE 19.—If possible, grass-like plants should be bent, not cut, to fit on the mounting board. Artist: C. Smith.

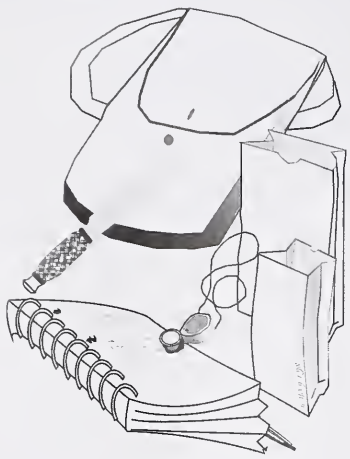


FIGURE 20.—Main equipment necessary for collecting bryophytes: collector's register and waterproof writing instrument, knife, brown paper bags, magnifying glass and shoulder bag. Graphic design: S. Turck.

soft and delicate and these specimens should be wrapped in tissue or newspaper to keep them intact and to prevent damage from the hardening soil.

- Some aquatic bryophytes, e.g. species of the peat moss genus *Sphagnum*, hold large quantities of water which should be carefully squeezed out.
- The substrate (rock crevice, cliff, boulder, wall, overhang, soil over rock, gravel, sand, loam, clay, tree trunk, branch stump, root, fallen or decaying log, leaf litter, humus, concrete etc.) should be recorded for each bryophyte specimen.
- Air-dry specimens as soon as possible after collecting to avoid fungal and abnormal shoot growth, and to discourage attack by insects. This can be done by opening the paper bags in a dry place with good ventilation. Alternatively, when time and space are limited, place specimens in a net that can be closed and suspended by a drawstring. Artificial drying procedures should rather be avoided.

◆ Aquatics

See Chapter 6 (page 45).

4 Drying

4.1 Equipment

- Plant presses or dryers-cum-presses.
- Dryers: field dryers or permanent ones, or the heat of the sun.

4.2 Method

- The drying process should take place in a warm, dry place which is not too hot, as plants tend to become very brittle if the temperature is too high. The critical drying temperature is given as 45°C.
- Plants must dry out fairly fast, otherwise the flowers or leaves tend to drop.
- The number of drying papers used will depend on the moisture content of the plants being pressed.
- The layers of drying paper must be changed regularly as they become damp from the moisture absorbed from the plants. This process should be repeated daily, especially during the first few days, and later continued at longer intervals (unless the relative humidity is very high) until the specimens are completely dry.
- It is not necessary to remove specimens from their flimsies when changing the drying paper.
- Cardboards must be changed as well, especially during the first few days.
- Before fully dried, the specimens should be loosened from the flimsies. Many plants parts tend to adhere to the flimsies during the drying process and are then difficult to remove later without some damage to the more delicate parts.
- The tissues of succulents and bulbous plants often have to be killed before the drying process will proceed. See page 25 for methods to deal with this problem.
- In general, if plants appear to be drying too slowly, put the press in a deepfreeze for a day or two and then return it to the drier.
- Continuously check for live insects eating the flowers and leaves while the specimens are in the press.
- A specimen is dry when a white mark is left behind after running one's fingernail along the surface of a leaf.
- Bryophytes: see page 30.

Natural drying can be effectively achieved by means of the sun, especially in areas of low humidity and if the specimens are not too succulent. Plant presses can be left outside in the sun and wind to dry but should be taken indoors as soon as there is a chance of dew or rain since the drying paper will absorb the moisture.

Field dryers are useful, especially if the humidity is very high, the plants are very wet or have a high moisture content, or if one is in the field for a long time. There are a number of different designs. Basically the press is placed above a heat source and the warm dry air is allowed to circulate through the ventilators (e.g. corrugated cardboards) (Figure 21). If intense heat is produced, it must be spread in some way to pre-

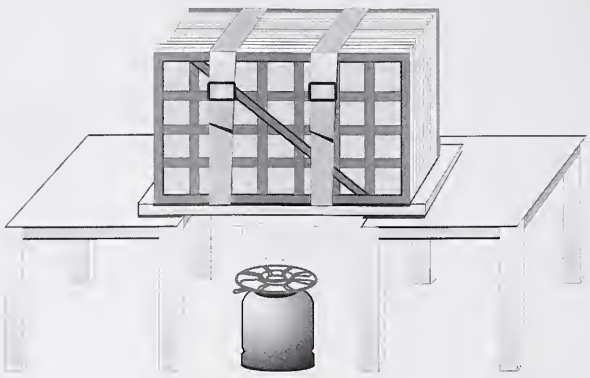


FIGURE 21.—The basic set-up for field drying: plant press raised above a heat source on a base which spreads the heat. Beware of fire! Graphic design: S. Turck.

vent concentration of heat at one point, which can set the press alight. Beware of fire!

Dryers are usually operated by electricity. One design consists of a dryer into which the presses are placed. Another type is designed to press and dry the plants at the same time; the wooden lattice frames are removed and the rest of the press is placed in the drier. Depending on the design, the number of drying papers may be reduced and cardboards increased. When choosing a dryer, the following points should be taken into consideration:

- Size or capacity: there should be enough space to accommodate all the presses or material brought in at one time.
- Efficiency: specimens should dry quickly, but should not be overdried and become too brittle.
- Ease and speed with which the material can be deposited straight from the press into the dryer-cum-press type.
- Possibility of a fire hazard: remember that the contents of a plant press can easily ignite.

5 Mounting

Dried material tends to be rather brittle and can be easily damaged, but mounting lessens the possibility of damage. Well-mounted specimens that are well-cared for can last indefinitely. Mounted specimens are easier to work with than unmounted material and provide much information efficiently. Bryophyte specimens are not mounted on herbarium sheets like other plants but are put in envelopes or packets kept in a vertical filing system—see 5.12.

5.1 Main aims

- To display the specimen to allow maximum observation of all characters (Figure 22). Once mounted, a specimen is more or less fixed in that position.
- To display all data (labels) clearly.
- To prevent damage and to preserve the specimen by attaching it firmly to strong acid-free paper or board.
- To use materials of attachment that can be easily removed and replaced. This allows better observation of specimens and removal of small portions for more detailed study.
- To make the collection easier to handle and more accessible for study or reference.

5.2 Equipment and materials

If the plant collection is for a long-term project or a standard herbarium, specimens should be mounted on sheets of archival cardboard using archival-quality paper for straps and an adhesive such as methyl cellulose.

- White mounting boards of good quality, preferably acid-free, of a standard size (270 × 420 mm) and ply (4- and 6-ply). They are used to support the specimens, which are permanent records in the herbarium.
- Scissors, knife, forceps and scalpel.
- Small, flat steel weights, for holding down parts of the plant while mounting.
- Wood glue or archival adhesive and applicator.
- Paint brushes, for gluing and removing dirt from the specimen.
- Paper towels or toilet paper, for mopping up excess glue.
- Needle and thread such as raffia, for attaching extra bulky parts.
- Thick corrugated cardboards, slightly larger than mounting boards (280 × 420 mm), for supporting the specimens while glue is drying and to aid the drying process by allowing circulation of air.
- Wax paper (slightly larger than the mounting board), stapled on to drying paper and placed on top of freshly glued specimens, to prevent the glue from sticking to the sheets above while it is drying.
- Sand bags (about 5 kg in weight), for putting pressure on a stack of specimens while the glue is drying.
- Piece of wood or any other firm surface the same size as a mounting board, to place underneath the sandbag to ensure its weight is evenly spread.

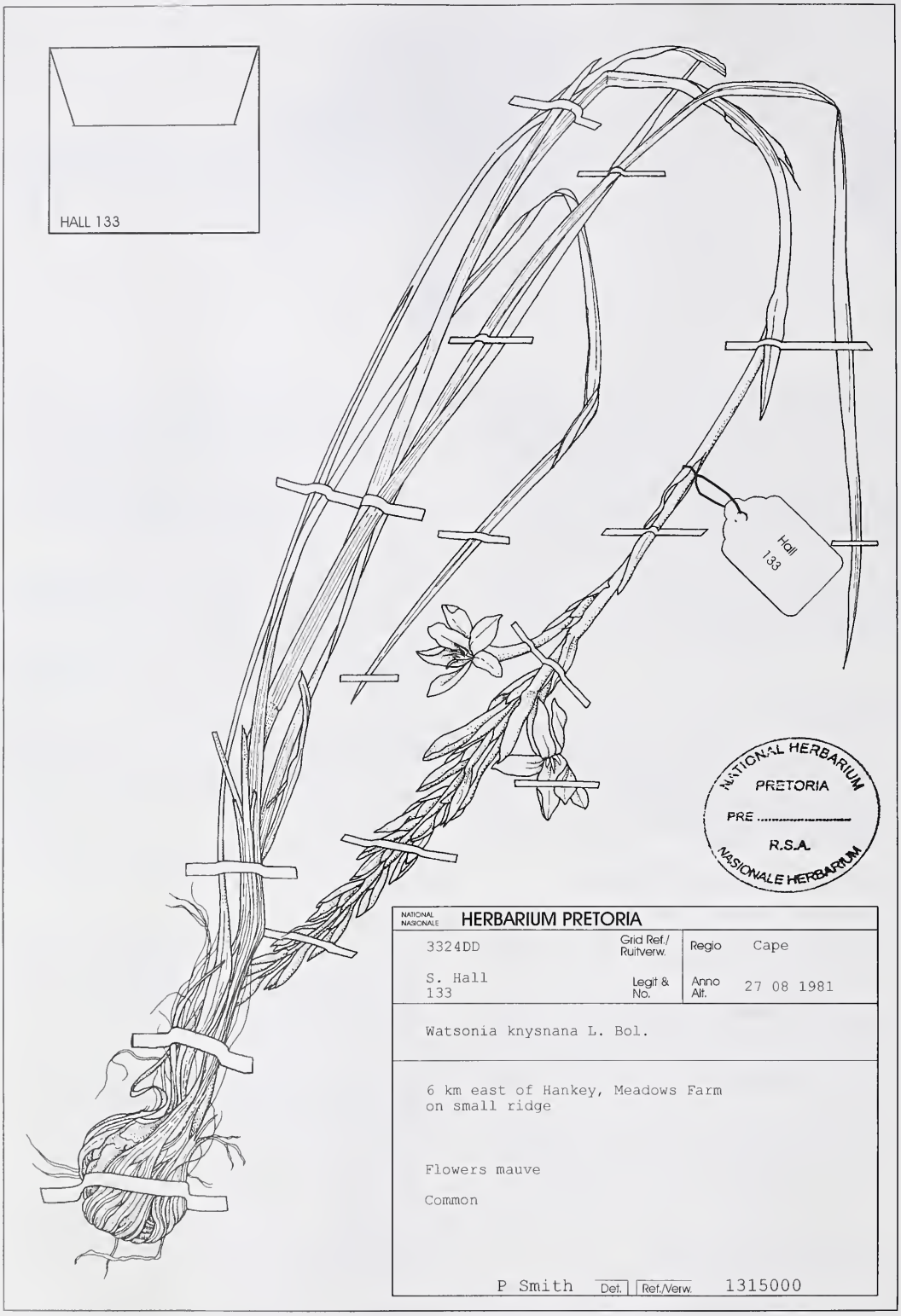


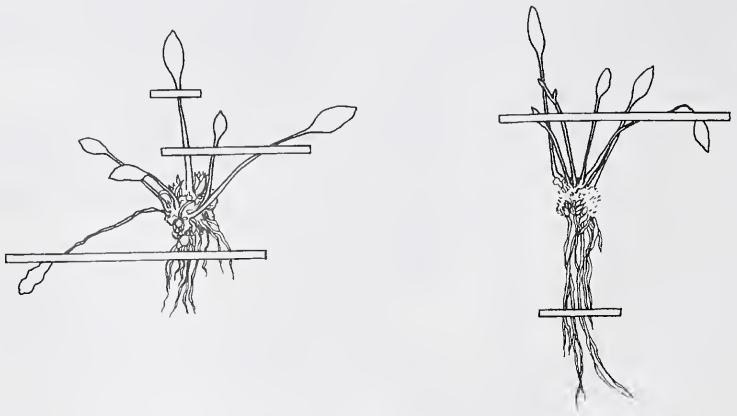
FIGURE 22.—Specimen mounted in diagonal position and attached with straps. Note the position of the main herbarium label, the stamp indicating the herbarium where the specimen is housed, the number tag and envelope containing extra material. Artist: G. Condy.

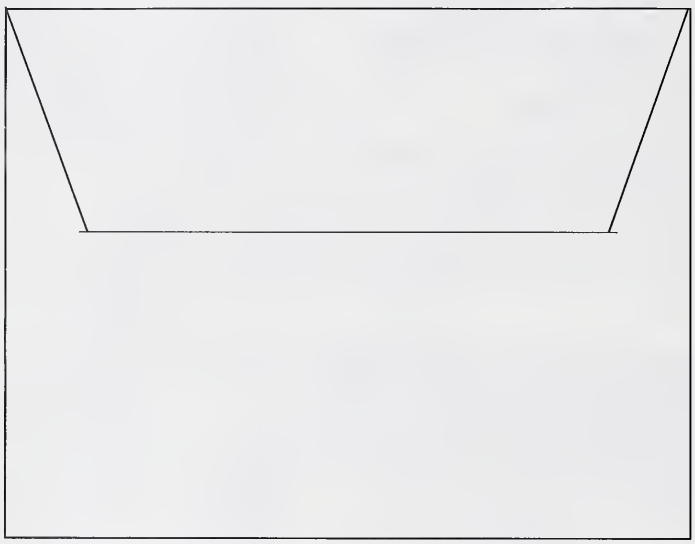
- Rolls of gummed paper (white and brown) cut into straps, for attaching specimens to their mounting boards.
- Apparatus for cutting gummed paper straps.
- Sponge and saucer with water to wet straps.
- Envelopes or capsules, for small or extra flowers, fruits, leaves or seeds.
- Pen with waterproof ink, pencil and rubber.
- 'Sheet I' to, for example, 'Sheet IV' labels used for indicating that a specimen consists of more than one mounting board.
- Herbarium stamp and pad (other methods are available). The specimen is stamped on the right, above the main data label, to indicate that it belongs to a specific herbarium (Figure 22).
- Duplicate folders or flimsies.
- Firm brown paper used as mounting sheets for duplicates not to be sent out as exchange or gifts to other herbaria.
- Apparatus such as a photocopier to make duplicate labels.

Dried plants are brittle—handle with care.

5.3 **Résumé of procedures**

- *Specimens should always be handled with great care*. Many specimens are irreplaceable and damage or the loss of fragments would render them scientifically worthless. A well-planned working routine and well-organised working space together with all the necessary equipment and materials neatly laid out and close at hand, lead to efficiency and hardly any damage to specimens.
- When mounting, remember that dried plants are very brittle and are easily damaged.
- Never shuffle specimens in such a way that the sharp edges of a sheet cut the underlying specimen.
- Care must be taken not to rest books, heavy objects or elbows on unprotected specimens.
- Keep mounted sheets and flimsies containing unmounted specimens flat and fully supported on corrugated boards, especially when carrying them from one area to another.
- Hands must be clean.
- Read and follow instructions directed to mounters that may accompany the specimen.
- Glue main label in the bottom right-hand corner.
- Never glue only one edge of any label.
- Ensure that all labels have been retained with their specimens, especially the original collector's label.
- Leave space above the main label for the herbarium stamp and any other labels.
- If necessary, select the best specimen(s) from the duplicates, showing all the characters and variations of the plant in the collection.
- Clean off soil.
- Place the plant in the best position on the mounting board, not too near the edges.
- Spread out the specimen to show all the characters. Do not clump parts together for easier and quicker mounting.
- Place any small extra portions in capsules or envelopes and then glue these to the mounting board. Make absolutely sure that such fragments accompany the correct material. Write the collector's name and number on them in case they become detached.
- Glue the specimen on to mounting board. Then place it on a corrugated spacing board and cover the specimen with a wax paper mounted on a drying sheet. Make a stack of specimens, place a firm piece of wood on top, then a sandbag for weight, and leave to dry.
- Specimens on which the glue is drying must be handled with care, since movement may cause a specimen to shift or break.
- When the glue has dried, fasten all loose parts with gummed straps.
- Duplicates selected from extra material of good quality with a copy of the label are placed in flimsies unmounted, with the collector's name and number written on the outside, in the bottom right-hand corner.





NATIONAL NASIONALE **HERBARIUM PRETORIA**

3322DB	Grid Ref./ Ruitverw.	Regio	Western Cape
J. Lawson 292	Legit & No.	Anno Alt.	19 10 1998

Limosella capensis Thumb.

Beaufort West district. Rysthul farm, near house.

At edge of pan in drying mud.

Flowers mauve

H Meyer Det. | Ref./Verw. 7588000

FIGURE 23.—Plants too small or delicate for mounting are placed in a large envelope in the centre of the mounting board. An example is mounted outside the envelope. Designed by G. Condy and S. Turck.

5.4 Selecting material

- Mount all material selected as it was chosen for a good reason.
- Select specimen(s) if it has not already been done by the herbarium worker responsible for that group of plants. When selecting, the following should be represented if possible:
  - A complete range of stages—flower buds, flowers, young and mature fruits (Figure 3).
  - Both male and female flowers in the case of unisexual flowers.
  - The maximum range of variation of the species collected, e.g. variation in plant or leaf size, hairiness and growth form (Figure 7).
- Ensure that the specimen is complete with leaves, flowers and/or fruits (Figures 3 and 16).
- If possible, split up clumps of plants carefully to show all characters more clearly.
- Before mounting, check if there is any chance that material may have been mixed up. Be aware of dimorphic male and female parts/plants.

5.5 Placing plant material on the mounting board

- *Be careful*—dried plants are brittle.
- Select acid-free mounting boards of the appropriate ply:

  4-ply for delicate to average specimens,

  6-ply for more robust or bulky specimens.
- Do not merely show the most pleasing or artistic arrangement, but keep the scientific purpose in mind.
- Do not make plant-like arrangements with loose material, but mount it separately or place it in a capsule or envelope.
- Clean off sand and dirt adhering to the specimen, using a fine paint brush or by gently blowing on the specimen.
- Avoid placing the plant on the extreme edges of the board, especially on the left, as it is likely to have more pressure exerted on it in the genus and/or species covers and material could be damaged.
- Specimens should not protrude over the edges of the mounting board.
- Specimens should not be mounted underneath or over the main label.
- Choose the best way of presenting the specimen to display all its characters.
- Choose the best side of the plant to display as many features as possible.
- Spread out the various parts of the plant for easy observation (Figure 5). If possible, do not clump or strap parts close together or on top of one another. Use small weights to hold parts in position.
- If parts of the specimen have to lie on top of each other, try to mount the more delicate parts below the bulkier parts.
- Expose hidden flowers or fruits by removing excess leaves and placing them in a paper envelope or capsule, together with any other small loose parts. If necessary, larger parts can be mounted separately on the sheet (Figure 4).
- Display both sides of leaves and flowers. If necessary, detach and turn one over before mounting (Figure 4) or place it in an envelope or capsule. In some herbaria it is standard practice to remove some floral material and place it in a capsule for future dissections.
- Ferns: show both fertile and sterile surfaces of fronds (Figure 15).
- When mounting more than one plant on a mounting board, try to keep them all aligned in the same direction (Figure 7). If possible, always place the largest or heaviest specimen at the bottom to prevent the sheet from bending when it is handled.
- Many larger specimens are best arranged diagonally, as this provides more space than placing them longitudinally and also prevents parts of the specimen from lying behind the label (Figure 22).

- Tiny plants too small to mount and very delicate specimens or parts should be placed in an envelope or capsule glued near the centre of the board. If possible, mount one or two on the sheet outside the envelope to show the plant represented in the envelope (Figure 23).
- Mature inflorescences of certain plants such as species of *Salix* and *Typha* sometimes tend to explode into cottonwool-like masses. In such cases, the inflorescences could be wrapped in plastic before mounting or the mounted specimen could be kept in a plastic bag.
- Trim plants only if there is no other way to fit them on a standard mounting board. Place important fragments in a paper envelope or capsule.
- Trim lumpy specimens with projecting spines or branches that could damage adjacent sheets in the herbarium cabinet.

5.6 Methods for attaching specimens

The main methods are gluing, sewing with thread, and strapping with gummed paper. A combination of these methods is best for most specimens since one method reinforces the other.

Gluing

- The what and why of gluing
  - Ensures that the specimen is firmly attached to the sheet, thus reducing damage.
  - Gives good support to larger specimens.
  - Wood glue is long-lasting and dries clear. In general this glue should be used only for robust parts of the plant. Delicate parts or those often needed for dissection should not be glued but if necessary, a water-soluble glue such as methyl cellulose must be used.
  - Gluing is irreversible and often covers important characters. Therefore, do not use too much glue for mounting.
- Methods
  - Glue is applied to the back of the specimen.
  - Do not cover important characters such as flowers, inflorescences (especially those of grasses), fruits or seeds.
  - Do not apply too much glue to the base of plants as it may cover important features like scales or hairs, especially important in ferns.
  - Too much glue prevents easy removal of portions for study.
  - Wipe off any excess glue with paper towel or toilet or tissue paper.
  - Application methods:

    Applying glue with a brush. This can be a quick method, but easily detachable, important fragments may cling to the brush and be lost. Fragments also dirty the glue.

    Spreading glue on a flat surface. This can be done on a sheet of glass or a bathroom tile, placing the specimen on the glue, then picking it up with a forceps and attaching it to the board. It is a useful technique when dealing with small or delicate specimens with fine stems.

    Squirting glue from a nozzle applicator. The glue is applied directly to the reverse side of the specimen. The applicator requires frequent cleaning to prevent clogging.
  - Delicate leaves may absorb the water in the glue and curl up. Therefore it is best to work fast and apply the glue in one action.
  - Each specimen that has been glued must be covered with wax paper (usually attached to a drying sheet for support). These specimens are then stacked between corrugated boards, with a sand bag supported by a piece of flat wood on top of the stack, and left under pressure until the glue has dried. Unevenly bulky specimens are kept separate from the main stack. The waxed paper prevents any excess glue that oozes out under the weight from sticking to the mounting sheet above.

Sewing with needle and thread

- Aim and specifications
  - To reinforce and attach very bulky parts of a specimen to the mounting board.

Natural raffia is recommended for this purpose. Strong, but not too thick thread is also suitable.

◆ Method

- Stitches are knotted off on the back of the mounting board and the knots are covered with strips of gummed paper to prevent the thread from catching on underlying specimens when filed in the herbarium.

Strapping with gummed paper straps

◆ Aims

- To hold a specimen firmly in place on the mounting board.
- To protect all loose parts that can be easily damaged.
- To allow for easy removal of portions for detailed studies, since strapping is a reversible process.

◆ Method

- All loose parts not glued down must be fastened with gummed paper straps.
- Apply enough straps to hold the specimen firmly in place, should the glued parts come unstuck. However, too many straps may hide important characters of the specimen.
- Straps of suitable width should be used (2 mm, 3 mm or 6 mm). Use narrow straps on finer parts of the specimen and wider straps where extra strength is needed, for example over thick stems.
- Straps should be 10–15 mm long on both sides of the plant part to be strapped down.
- Straps should be tucked in under the plant parts so as to hold the specimen firmly in place (Figure 22).
- Use forceps to tuck straps firmly around and under stems.
- Avoid strapping over important details such as flowers, small inflorescences or the base of a plant. Exceptions to the rule are large flowers or flowering heads and very long, delicate inflorescences that obviously need extra support to prevent damage. In such cases straps should be placed near the base and along convenient points.
- Straps are placed across the specimen at regular intervals and stuck to the sheet at both ends (Figure 22).
- A strap should not cover large amounts or different thicknesses of material, as it would be difficult to stick the strap properly and the plant would not be held firmly.
- Straps are usually aligned in one direction wherever possible, preferably parallel to the bottom of the mounting board. However, mounters must use their discretion as it depends to a large extent on the specimen being mounted (Figure 22).
- When strapping across a leaf blade, attach only the ends of the straps where contact is made with the sheet, allowing the leaf to move freely when the sheet is handled.
- Do not over-wet straps, otherwise they will fail to stick to the sheet.
- Gently feel to make sure all the parts have been fastened down.

5.7 How to mount labels

Types of labels (Figure 24)

◆ The main herbarium or data label provides the essential information about the specimen and should be present on all specimens.

◆ Determinavit and confirmavit labels.

◆ 'Cited as' or 'Quoted as' labels.

◆ Labels indicating that a specimen has been noted in a special research project such as anatomy, cytology, palynology or cancer research.

◆ An institution's label which is used if the herbarium or data label does not include the name of the herbarium in which the specimen is to be housed or the label carries the name of another institution.

◆ 'Sheet I' to, for example, 'Sheet IV' labels indicating that a number of sheets were

used to mount one collection, as in the case of highly variable species to show the full range of variation or for exceptionally large specimens or specimens with many parts.

- Special labels for indicating the status of certain specimens such as types.
- Original collector's labels, especially handwritten ones.

Methods

- New labels should be typed or copied if the main labels are of a poor quality, but the originals must be retained with the specimen. Mount the originals in the top left-hand corner, either directly on the sheet or in an envelope.
- Very large labels should be folded and placed in envelopes or capsules and the essential data copied on a standard-sized label.
- Before separating any labels from a specimen for photocopying, retyping etc., make sure that the collector's name and number have been recorded somewhere with the unmounted specimen.
- Check the reverse side of labels for maps or any other information.
- The best position for the main label is in the bottom right-hand corner. This makes the label easy to read when the specimen is filed in a genus cover in the herbarium, which always opens on the right.
- Do not place the label across any part of the specimen or underneath it.
- Never glue only one edge of a label, as partly fastened labels tend to tear with time.
- Place glue sparingly round the edges of the entire label, place it on the mounting board and smooth it out with a paper towel or piece of flat, clean cardboard.
- Wipe off excess glue with paper towel.
- If possible, additional labels and the herbarium stamp should be placed above the main label, or at least close to it.

5.8 **Paper envelopes or capsules**

Aims and specifications

- To contain and protect small loose portions of a specimen.
- To contain and protect specimens too small or delicate to mount.

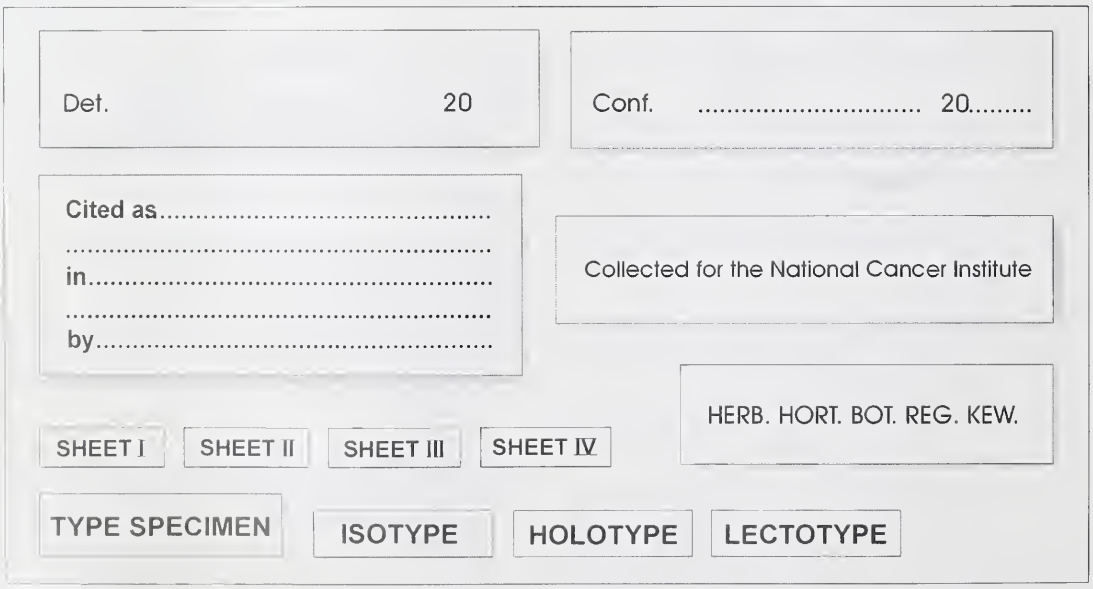


FIGURE 24.—Labels that, apart from the main herbarium label, may accompany a specimen that has to be mounted. Graphic design: S. Turck.

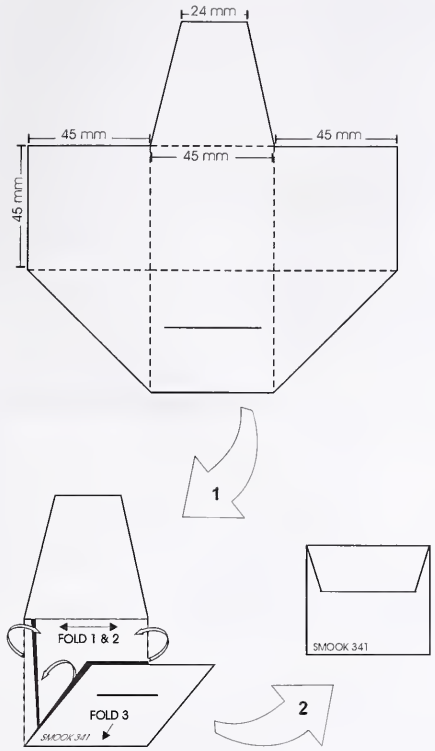


FIGURE 25.—Template, measurements and folding procedure for making an envelope or capsule in which extra material can be mounted with a specimen. Graphic design: S. Turck.

- When folded and glued to the board, the capsule should stay closed and not allow small seeds or parts to fall out. It should fold open flat to allow observation, without damage to the plant parts.
- Standard sizes are 45 × 45 mm, 67 × 67 mm and 88 × 88 mm. There are a number of different designs (Figure 25) used by different herbaria.
- At some herbaria it is standard practice to mount an envelope with every specimen to facilitate easy retention of dissected material later or any seeds or other material that may become loose from the specimen.

Methods

- Use the appropriate size.
- Write the collector's name and number on the outside of the envelope or capsule.
- Transfer fragile material with a pair of forceps, or slide a small piece of stiff paper under the delicate item to be lifted.
- Envelopes are usually placed at the top left of the mounting board, but mounters have to use their discretion as it depends on the specimen that has to be mounted.
- If a specimen is not to be mounted but rather placed in an envelope or capsule, position the envelope in the centre of the mounting board (Figure 23).

5.9 **Number or jeweller's tag**

This tag bears the collection number of the specimen and is usually attached to the specimen by a thread. It must be preserved with the specimen by gluing it to the sheet (Figure 22), but if there is writing on both sides it must be tucked under part of the specimen.

5.10 **Duplicates**

Aims and specifications

- To provide excess fertile material to send to other herbaria either as a gift or as exchange material.
- Duplicate folders or flimsies are used for sending unmounted duplicate specimens to other herbaria. The folders should be thin but strong and the same size as a mounting board (270 × 420 mm).
- Brown paper sheets, the same size as a mounting board, are used for mounting duplicate specimens not to be sent out to other herbaria. Flimsies can also be used for this purpose. In both cases the specimens are only lightly strapped, using only a few straps. These specimens are filed in the main collection.

Methods

- If possible, each duplicate should have the complete range of stages represented in the collection: flower buds, flowers, young and mature fruits.
- Sterile or incomplete specimens should not be sent to other herbaria.

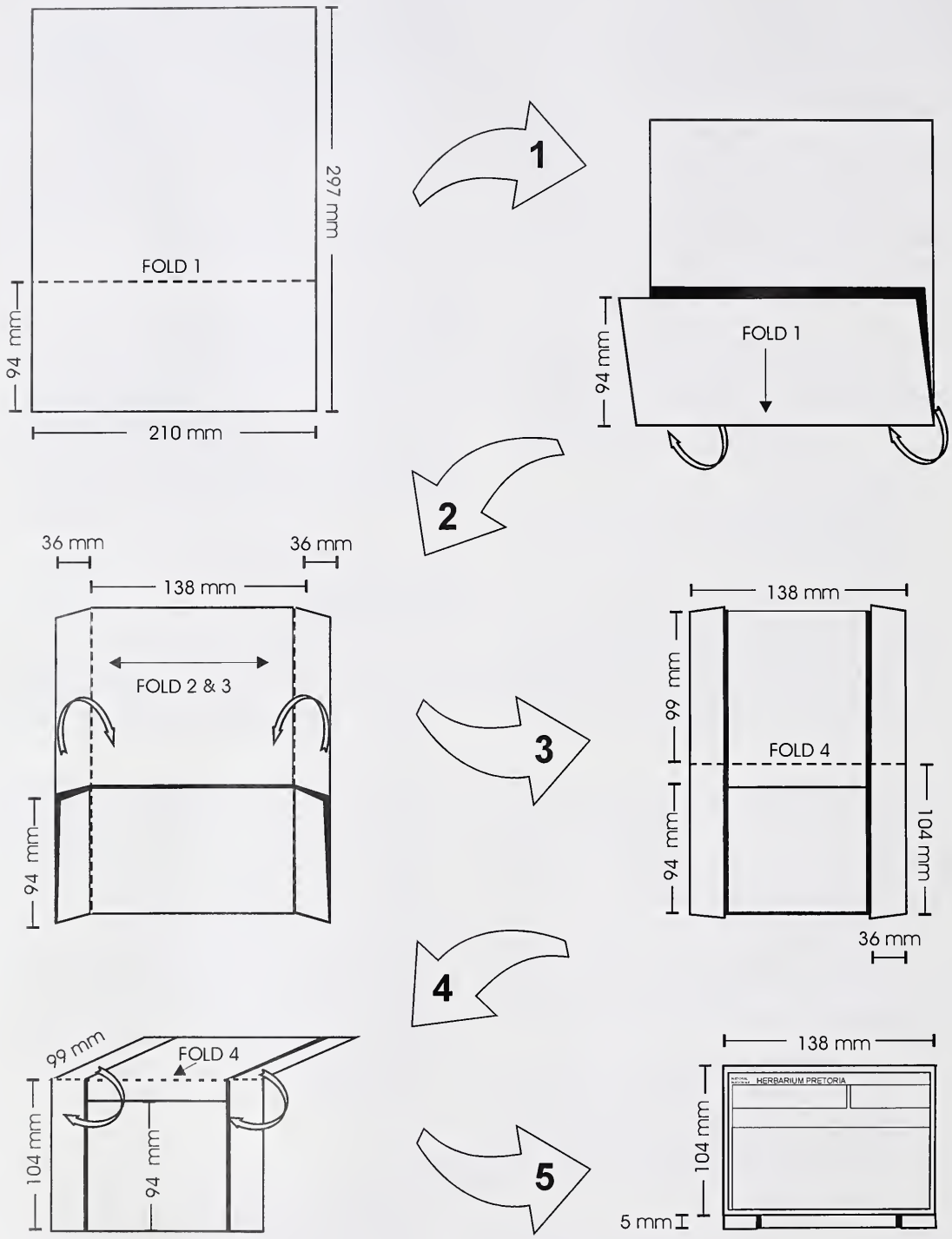


FIGURE 26.—The folding sequence and measurements for making special packets from A4 paper used for filing bryophyte specimens in a herbarium. Graphic design: S. Turck.

- If the flowers are unisexual, both male and female flowers should be represented in each duplicate.
- Variable species should show the maximum range of variation on each duplicate.
- Ensure that the correct label is placed with each duplicate.
- Each duplicate is placed in a flimsy and the collector's name and number are written on the outside in the bottom right-hand corner of the flimsy.

5.11 **Remounting and repairing**

Why and when to remount and repair

- If specimens received are on mounting board of inappropriate quality or size.
- If straps or glue has come undone.
- If the mounting board has been damaged or become fragile with age.
- If two different gatherings have been mounted together, either deliberately as practised in the past or accidentally because they have not previously been recognised as a mixture.

Methods

- It is important that divided portions of a sheet bear cross references to each other stating 'Separated from ..... '. This is a safeguard if an error is made when dividing a sheet, for example by leaving the wrong label with the specimen. When a sheet of specimens is divided, it is important to change the collector's number on one or on both new sheets. This is usually done by adding A or B to the number.
- Preserve all labels and notes written directly on the mounting board.
- A faded or fragile label can be replaced with a newly copied version, but the original must be kept in an envelope or capsule. This is then glued to the board, preferably in the top left-hand corner.
- Strapped specimens can easily be removed from the paper by disengaging the gummed paper straps with a forceps, removing or cutting around the label and then remounting on new mounting boards.
- Glued specimens should be detached from the sheet only if it can be done without harming the specimen. Otherwise the sheet should be cut around the specimen and label(s), and the cuttings then remounted.
- If only part of the specimen has broken loose from the sheet, repairs can be carried out without entirely remounting the specimen.
- If the mounting board is of a good quality but the wrong size and the mounting is good, the board can be glued to a sheet of the appropriate size.
- Specimens in need of repair, regluing or separation should be dealt with as soon as the problem is noted.

5.12 **Handling bryophytes**

- Bryophytes should not be mounted exposed on cardboard sheets like other plants as it will only result in damage and loss of material. Because of their size, bryophytes are well suited to a vertical filing system in envelopes or in specially folded packets designed to keep specimens safe but accessible.
- Excess soil and leaves should be removed on a fine soil sieve without disturbing delicate cushions or specimens collected on crusts of soil.
- Do not wash or press the specimens.
- Herbarium packets for bryophytes can be made to fit the size of an available box or cabinet. A useful standard packet of 104 × 138 mm can be folded from an A4 sheet of paper (Figure 26):
  - Place a sheet of A4 paper on a flat surface, orientation portrait.

- Bring the lower edge of the paper upwards 94 mm for the first fold, square the sides and crease the fold.
- Fold each side over 36 mm, square the lower edges, then crease each of the side folds.
- Fold the top downwards to ± 5 mm from the bottom of the packet, square the sides and crease the fold.

- Collecting data can be written on the packet or a label can be glued to the outer flap.
- Very small and delicate specimens should be placed in smaller envelopes or wrapped in tissue paper, placed inside the herbarium packet.
- Once dry, bryophytes are rarely attacked by insects and no special precautions are necessary in this regard.

6 Pressing and mounting aquatic plants

Contributed by René Glen

6.1 Why special techniques?

Aquatic plants are those that grow in close association with water. They are physiologically and/or morphologically adapted to complete their life cycle in this aquatic habitat (Figure 27). Their growth form is used in many identification keys and it is therefore important to note where and how the plant is growing in the water. Because aquatic plants are wet, they need special attention when being prepared as herbarium specimens. They need several sheets of drying paper and a cardboard ventilator between all specimens, which must be changed frequently. The problem with pressing aquatic plants is that the leaves especially have a thin mucilaginous covering layer acting like a glue and sticking the specimen to the flimsy. The collector can easily end up with dried fragments of leaves. The petals are thin and delicate and also tend to stick to the flimsy. A protective layer of wax paper, thin perforated plastic or cloth can be placed over the plant to prevent it from sticking to the flimsy. The use of these protective layers and preparation of the different growth forms for herbarium specimens are discussed below.

6.2 Emergent plants

Emergent aquatic plants are those growing towards the edge of a water body (Figure 27). They can be either upright, for example mem-

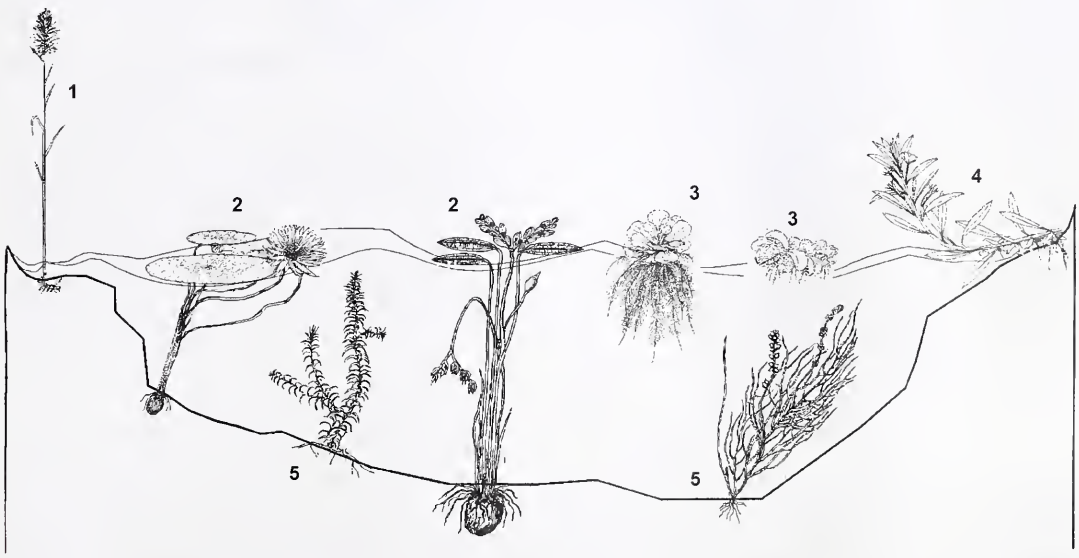


FIGURE 27.—Profile showing different types of aquatic plants: 1, emergent; 2, floating attached; 3, free-floating; 4, emergent and horizontal; 5, submerged attached. Graphic design: S. Turck.

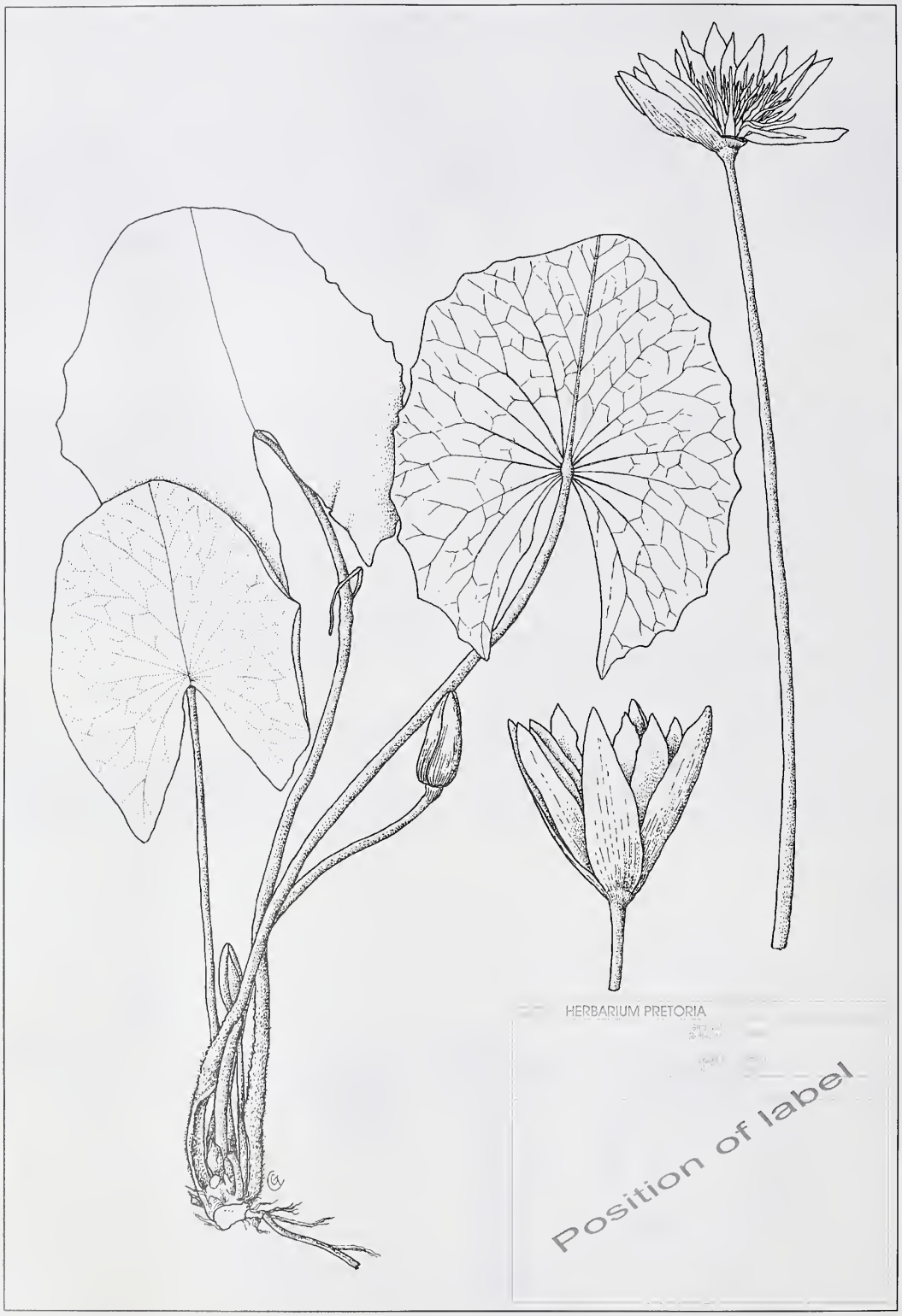


FIGURE 28.—Some flowers should be laid open and others turned over. If possible, the features of the stamens and pistil should be visible. Leaves should be pressed and mounted in such a way that both surfaces are shown on the specimen. Artist: G. Condy.

bers of the Cyperaceae, Poaceae or Juncaceae, or procumbent, usually floating on the surface but with their roots embedded in the soil or mud at the water's edge, for example species of *Ludwigia* and some of the Poaceae.

If possible, collect young as well as mature plants, thereby ensuring that all the characters necessary for identification are present. The form of the rootstock is used in identification of these plants to species level and it is therefore essential to include the roots or rhizomes. All mud or soil must be removed before pressing so as not to obscure any of the characters used in identification, for example the thickness and length of the roots, the shape of the rootstock, whether it is a creeping rhizome or a corm and how the leaves emerge from the rootstock. The number of leaves emerging, the arrangement of the leaves as well as the inflorescence are also essential characters that have to be observed when identifying these plants. Otherwise the procedure for pressing them is very similar to that for terrestrial plants.

Inflorescences of *Typha* species (bulrushes) tend to explode on the herbarium sheet after some time. It is advisable when mounting these plants to wrap a sheet of plastic or cellophane around the inflorescence, tying both top and bottom to prevent the minute flowers from spreading if the inflorescence does explode. This precaution still enables researchers to examine the flowers at a later stage.

6.3 **Floating attached plants**

These are aquatic plants of which the roots are embedded in the substrate and the leaves float on the surface (Figure 27). The flowers are either on the water's surface or just above it. This is often a diagnostic character and needs to be included in the field notes. Examples of this group are species of *Nymphaea* (water lilies), *Nymphoides*, *Ottelia* and *Aponogeton* (*waterblommetjies*).

When identifying *Nymphaea* species, one must be able to count the number of stamens and see the shape of the petals. The flower can be cut in half or some of the petals and stamens can be folded forward to show the arrangement and number of the stamens (Figure 28). The venation of the upper and lower surface of the leaf is also very important. If the leaves are small, press two, so that both surfaces can be observed on the herbarium specimen. Larger leaves can be cut in half, slightly off-centre. Because the way the veins join the petiole is often used as a criterion, the leaf should be mounted in such a way that this is visible.

The mucilaginous layer will act as an adhesive. Therefore, spread the plant out on a white sheet of paper as it would be mounted on the herbarium sheet, then cover it with a protective layer. Some aquatic plant scientists from America and Europe use wax paper or thin perforated sheets of plastic as a protective layer. However, experiments with these have not been very successful: in both cases the flowers stuck to the protective layer and broke. The heat from dryers tends to melt the wax from the wax paper, thus leaving a thin layer of wax on the flimsy and on the specimen. This waxy residue affects the appearance of the surface of the specimen, causing problems if electron microscope work, for example, has to be done on the specimen at a later stage. In the field, where the plants are not dried under such intense heat as in a dryer, wax paper can be used, but it is essential to prick several holes in the paper so that the moisture on the plant can be absorbed by the drying papers. Thin perforated plastic film may work in cooler climates but is not recommended in tropical areas.

In the past some collectors used tissue paper, absorbent kitchen towel or toilet paper as protective layer, but the plants adhere to the paper and it is very difficult to separate them from it. If this is indeed achieved, the specimen is left with several fibres adhering to its surface, leaving the specimen with a 'hairy appearance' which could result in the wrong identification.

Marine algae are pressed between two pieces of thin cotton cloth (cheesecloth) and this seems to be the best method for all aquatic plants as well. A slight weaving pattern is impressed onto the specimen but it does not appear to affect identification. Dressmaker's noniron-on interfacing has also proved a very effective protective layer. Nappy liners have been suggested, but their effectiveness is not known.

It is advisable to pack the press in the following manner: cardboard ventilator, drying paper, flimsy with specimen and its protective layers, drying paper and another cardboard. This allows for good ventilation and the plants dry quickly.

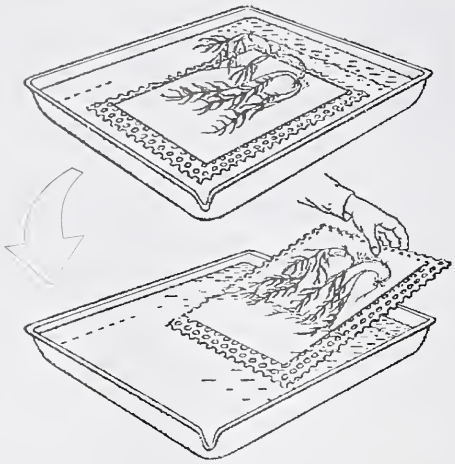


FIGURE 29.—Preparing a submerged aquatic plant for drying and pressing by lifting the specimen out of the water on a clean sheet of white paper. Graphic design: S. Turck.

When the drying papers are changed, the plants should be *gently* loosened from whatever protective layer was used.

6.4 Submerged plants

These are plants of which the foliage is completely submerged (Figure 27). In some the inflorescence is raised above the water, for example species of *Potamogeton* (pond weeds) and *Lagarosiphon* (oxygen weed). In others the inflorescence is submerged, pollination then occurring in the water, for example *Zostera* species (sea grass). When these plants are removed from the water, the leaves adhere to each other, making it very difficult to identify the plant at a later stage.

Suggested ways of preparing submerged aquatic plants for pressing

- *Float the plant.* Immerse a clean sheet of white paper in water, in a flat, shallow dish (an old photographic developing dish works well), spread the plant out on the sheet of paper and *very gently and slowly* lift the sheet of paper and plant out of the water (Figure 29). A thin sheet of polystyrene under the paper would help to support both plant and paper during the lifting process.
- *Air-dry the plant.* Place delicate plants in a cotton bag and swing it around a few times, shake it gently and then spread the plant out on a sheet of white paper; more robust plants can be shaken dry without using a cotton bag (pers. comm. Prof. C.D.K. Cook).

With both the above methods, press and dry the material in the conventional way using a plant press and/or dryer. The plants will adhere to the paper, which can then be mounted straight onto the herbarium mounting board. Where the plant does not adhere to the paper, it can be secured with a few gummed paper straps.

6.5 Free-floating plants

These plants float on the water's surface and are not attached to the substrate (Figure 27). Examples are *Eichhornia crassipes* (water hyacinth) and species of *Azolla* (water fern), *Lemna* (duckweed) and *Spirodela*.

In the case of large plants such as *Eichhornia* and *Pistia* (water lettuce), the whole plant is mounted. Special care must be taken with the fragile flowers of *Eichhornia*. Place a small piece of white paper under the flower, spread the flower out on it and cover with a piece of cheesecloth. When changing the drying papers, gently loosen the flower from the cloth; the delicate petals will stick to the paper supporting the flower. The method described under the heading *Fragile flowers* (page 27) can also be used for these flowers. Likewise, a method also suitable for pressing flowers of succulent plants could be applied: cut a square piece of gummed white paper slightly bigger than the flower, moisten the gum paper, spread the flower out on it and cover with a piece of wax paper of similar size (pers. comm. P. Burgoyne).

Small free-floating plants such as *Lemna* are individually placed on a square piece of white paper about 75 × 75 mm. Most of the plants will adhere to the paper. Later when the herbarium specimen has to be prepared, one square of paper with the *Lemna* adhering to it can be mounted on the herbarium sheet so that the plants are visible for normal herbarium use. The remaining squares and any loose plants can be placed in an envelope mounted on the sheet.

7 Selected plant groups

Collectors should know that there are specific plant parts that are essential for correct identification of certain groups. In some cases the plant part has to be cut, prepared or mounted in a special way to reveal a specific character. Listed below are selected plant families and other groups, with the parts or characters most needed by herbarium workers who have to compare and identify the material.

Acanthaceae	Flowers (collect and dry some extra) and fruit, including seeds, which are released as the specimens dry. Flowers often detach easily after collecting.
Aizoaceae	Mature fruit.
Alliaceae	Flowers and underground organs.
Amaryllidaceae	Bulbs and entire plant with flowers. Make notes on numbers and condition of leaves.
Apiaceae	Mature fruit essential. Basal and cauline leaves and underground parts desirable.
Araceae	Leaf and inflorescence. Note colour of spathe.
Arecaceae	Fruit, base and apex of leaf; height of trunk. Care should be taken not to damage the hastula at the base of the leaf of some species.
Asclepiadaceae	Flowers and/or fruit. Flowers and stems in fixative. Dig for roots.
Asparagaceae	Flowers and/or fruit and underground organs.
Asphodelaceae	Flowers and underground organs. *Aloe*: note height of plant, colour of flowers, leaf markings and colour of leaf sap.
Asteraceae	Flowers and mature fruit. Press some heads exposing upper surface, others showing lower surface and cut some longitudinally.
Cactaceae	Columnar species: cross-section of stem to show number of wings; piece of one wing; few unbroken spines; half a flower or fruit.
Campanulaceae	Note shape of corolla and make a cross-section of the ovary.
Caryophyllaceae	Mature fruit and seeds.
Celastraceae	Fruit.
Colchicaceae	Flowers and underground organs.
Commelinaceae	Flower colour, fruit and roots.

Convolvulaceae	Open flowers, split and pressed between tissue paper or presented on gummed cards. Ripe fruit and roots.
Cucurbitaceae	Correlated male and female collections are valuable because flowers are usually unisexual, plants often dioecious. Ripe fruit of which cross-sections and longitudinal sections should be made. Flowers and fruit in fixative.
Cyperaceae	Ripe fruit and underground parts. Very young inflorescences are of little value.
Ericaceae	Flowers and ripe fruit. Note any waxy bloom. Dry quickly to prevent leaves from dropping.
Eriocaulaceae	Inflorescences in different stages and base of plant.
Eriospermaceae	Flowers and underground organs.
Eucalyptus	Buds and mature fruit; juvenile/coppice and mature foliage.
Euphorbiaceae	Male and female flowers. Make notes on habit. Beware of poisonous sap or vapours.
Fabaceae	Flowers and fruit.
Ferns & fern allies	See **Pteridophytes**.
Gramineae	See **Poaceae**.
Hyacinthaceae	Flowers, fruit and underground organs. Some flowers should be dissected or spread out to show stamens and ovary.
Iridaceae	Flowers, mature fruit and underground parts. Press flowers immediately between tissue or wax paper or on gummed paper.
Juncaceae	Mature fruit and underground parts.
Lamiaceae	Note flower colour and markings, and smell of crushed leaves.
Lentibulariaceae	Underground parts, especially the bladders of terrestrial *Utricularia*.
Liliaceae	Flowers and underground parts. Some flowers should be dissected or spread out to show stamens and ovary.
Loranthaceae	Fruiting specimens alone are useless. Record host plant. Kill by treating with solvent, hot water or freezing and dry quickly to prevent leaf fall.
Malvaceae	*Hibiscus*: flowers split open and pressed immediately between tissue paper.
Mesembryanthemaceae	Flowers and capsules. Cross-sections of leaves. Press flowers immediately on gummed paper.
Nymphaeaceae	Shape of petals, number of stamens. Venation of leaves on both surfaces.
Ochnaceae	Flowers and fruit from the same plant. A section of mature bark or good notes or a photograph of it.
Orchidaceae	Flowers and fruit. Flowers in fixative. Note whether basal leaves are attached to flowering stem or separate stem.
Oxalidaceae	Flowers and underground parts (bulbs).
Palmae	See **Arecaceae**.

Pedaliaceae	Fruit and seeds are important.
Poaceae	The whole plant, including underground parts. Inflorescences should not be too immature or so old that only the glumes are left. As bamboos are usually sterile, culm sheaths and nodes showing branching should be collected for identification.
Polygonaceae	Fruit.
Pteridophytes	Fertile (definitely) and sterile fronds, especially if different. Collect immediately into press or seal in plastic bag to prevent wilting. When pressing, spread fronds open to show individual pinnae which may differ in shape and size along leaf. Rhizomes or root stock. Tree ferns: petiole, leaf bases and leaf scars.
Restionaceae	Female plants are essential. Collect male plants where possible.
Rosaceae	Fruit. Leaves from flowering and sterile shoots.
Rubiaceae	Fruit. Young and mature stipules.
Rutaceae	Mature flowers and fruit.
Scrophulariaceae	Flowers and/or fruit. Record hosts of parasites and semiparasites. Record flower colour as plants often turn black on drying. Rootstock of *Diclis* and some flowers to be pressed open for *Zaluzianskya* and others.
Umbelliferae	See **Apiaceae**.
Zingiberaceae	Underground parts. Inflorescence in fixative.
Zygophyllaceae	Mature fruit.

8 Field herbarium

In addition to or instead of a formal herbarium collection, it is sometimes desirable to have a portable reference collection which can be taken into the field or to keep a small reference collection of one's own. Since this type of herbarium is not archival, duplicates should be deposited in a standard herbarium. Of the many methods, the following two are quite useful—plant specimens or relevant portions are glued or stuck with gummed paper straps onto:

- Index cards, which are then preferably placed in zipper-type plastic bags which can be stored in filing drawers,

  or

- A4 mounting sheets, which are slid into punched plastic pockets and placed in an A4 ring binder or lever arch file.

Advantages of these two methods:

- Notes about a particular species can be made on the relevant sheet.
- The collection can be sorted by genera, families or habitat etc. at any time; one is not bound by a particular system.
- Being in loose plastic pockets, the specimens are easily accessible for examination but protected by plastic.
- The collection is easy to take into the field.

9 Health and safety hints for collectors

This chapter has been added to make collectors aware of certain health and safety points while out collecting and does not describe treatments or procedures in detail. It is up to the individual or organisation to apply the most up-to-date methods of treatment and procedures. A basic knowledge of first aid can save a life, as it is not always possible to get to professional help immediately.

Basic knowledge of first aid is useful and could be life-saving, especially when collecting in remote areas.

Allergies

- These are conditions that develop unexpectedly after contact with certain animals or plants. Antihistamine tablets and creams usually give relief, but severe cases need medical treatment.

Bee or wasp stings

- There is always a strong possibility of being stung by a swarm of wasps or bees in the field. It can result in a painful or dangerous allergic reaction, even in a presumably nonallergic person. It is therefore always advisable to carry an ample supply of antihistamine on a collecting trip.

Bilharzia

- Because many of our waters are infected, it is wise to take adequate precautions when collecting in and around water: use gloves and waders, for example.

Calm

- Stay calm, whether you have to deal with your own or someone else's problem.

Choking

- Heimlich manoeuvre is recommended.

Cardiac pulmonary resuscitation (CPR)

- Method used to revive a person who has stopped breathing, for example as a result of drowning, falling, choking, snakebite or being struck by lightning. Consult your doctor or any first-aid organisation for details.

Dehydration

- Drink fluids, especially water, frequently to prevent dehydration.
- Always carry plenty of drinking water, no matter where you go or for how long or short a time.
- The symptoms and treatment of dehydration should be known (consult a medical practitioner, first-aid organisation or literature on the subject).

Insect bites

- See **Allergies**; **Bee or wasp stings**; **Malaria**.

Lightning:

- If a person is struck and stops breathing, apply CPR (see above) immediately.
- If caught in an electric storm, wait it out in an area with many objects taller than yourself. As lightning is drawn to the highest point, it is not advisable to stand near or under isolated features such as tall trees, tents or pylons in open flat areas. Move down below the summit of a mountain or top of a hill and shelter under low trees or shrubs, or overhanging rocks.

Losing the way

- Anyone can get lost, especially in an unfamiliar area.
- Always carry matches or a lighter on your person so as to:
  - Light a fire to keep warm.
  - Make smoke to attract attention.
- Unless you are aware that you have walked a distance from your abode or vehicle, do not start walking into the unknown. Sooner or later your companions will call, and you may have walked out of range of their voices.
- Always be aware of your surroundings, try and keep points of reference in sight and do not wander aimlessly.

Malaria

- This is a very serious problem in many of our areas. Consult your doctor or pharmacist about the different prophylactic drugs needed for different regions.
- Symptoms may appear some time after a person has been infected. If you fall ill or have flu-like symptoms, inform your doctor that you have been in a malaria area.

Matches

- Always carry matches (stored in such a way that they will stay dry) or a cigarette lighter on your person on a collecting trip. See **Losing the way**.

Numbers

- The saying 'safety in numbers' also applies to collectors, especially in remote areas. The minimum number of persons on a collecting trip should be three—in the case of an accident, one can stay with the injured person while the third member of the group finds help.

Poisonous substances

- Many plants are poisonous.
- Do not use the same utensils for eating and cutting plant material for pressing.
- Wash hands after dealing with plants.
- Some woods are poisonous: be careful when using an open fire for cooking.

Snakebite

- It is advisable to keep up-to-date with the latest treatment. Methods other than anti-snakebite injections such as a high dose of antihistamine and immobilisation have been suggested. If a person stops breathing, apply CPR (see above).

Tetanus

- It is advisable to have boosters—consult your doctor.

Vapours

- Some plants have toxic or irritant vapours that can be harmful to the eyes.

Water

- Drinking water is the most important item for any collecting trip and plenty should always be available.

10 Further reading

ABBOTT, T. 1991. Plant collecting or how to get away with it. *PlantLife* 4: 6–7.

ABDALLA, S.H. & STYLES, B.T. 1986. A quick and efficient method of preserving plant material for herbaria. *Taxon* 35: 546–547.

BARKER, M.A., MOHLENBROCK, M.W. & PINKAVA, D.J. 1985. A comparison of two new methods of preparing cacti and other stem succulents for standard herbarium mounting. *Taxon* 34: 118–121.

BEDFORD, D. & JAMES, T. (Compilers) 1995. *Collection, preparation and preservation of plant specimens*, 2nd edn. Royal Botanic Gardens, Sydney.

BALKWILL, K. 1990. Projects for amateur botanists Part 2: compiling a checklist of a defined area. *PlantLife* 3: 26–29.

BURGOYNE, P.M. & SMITH, G.F. 1998. Preparing useful herbarium specimens of succulents and other plants with fleshy parts. *Aloe* 3 & 4: 102, 103.

CESKA, A. & CESKA, O. 1986. More on the techniques for collecting aquatic and marsh plants. *Annals of the Missouri Botanical Garden* 73: 825–827.

CLARK, S.H. 1986. Preservation of herbarium specimens: an archive conservator's approach. *Taxon* 35: 675–682.

CROAT, T.B. 1979. Use of a portable propane gas oven for field drying plants. *Taxon* 28: 573–580.

DE WET, H.F.C. 1980. Drying herbarium specimens in moist tropical conditions. *Boletim da Sociedade Broteriana* Sér. 2, 53: 549–553.

DONALDSON, J.S. 1993. The dead hand on discovery: permits for the study of protected plants. *South African Journal of Science* 89: 120–122.

DRANSFIELD, J. 1986. A guide to collecting palms. *Annals of the Missouri Botanical Garden* 73: 166–176.

EDWARDS, D. & LEISTNER, O.A. 1971. A degree reference system for citing biological records in southern Africa. *Mitteilungen aus der Botanischen Staatssammlung München* 10: 501–509.

EGGLI, U. & LEUENBERGER, B.E. 1996. A quick and easy method of drying plant specimens, including succulents, for the herbarium. *Taxon* 45: 259–261.

ENGELMAN, G. 1986. Instructions for the collecting and preservation of botanical specimens. *Annals of the Missouri Botanical Garden* 73: 504–507.

FORMAN, L. & BRIDSON, D. (Eds) 1989. *The herbarium handbook*. Royal Botanic Gardens, Kew.

FOSBERG, F.R. & SACHET, M. 1965. Manual for tropical herbaria. *Regnum Vegetabile* 39: 1–132.

GLAVOVIC, P.D. 1993. *Flora and the law. A review of existing laws that protect wild plant species in the Republic of South Africa*. Flora Conservation Committee, Botanical Society of S.A.

GLEN, R.P. 1997. Pressing and drying of aquatic plants. *PlantLife* 17: 34.

GREISSL, R., HORN, A. & VOGELEI, A. 1995. A modified thermal convection drying technique for herbarium preservation. *Botanical Journal of the Linnean Society* 117: 29–38.

HAMMEL, B.E. 1987. The origami of botany: a guide to collecting and mounting specimens of Cyclanthaceae. *Annals of the Missouri Botanical Garden* 74: 897–902.

HAYNES, R. 1984. Techniques for collecting aquatic and marsh plants. *Annals of the Missouri Botanical Garden* 71: 229–231.

HILL, S.R. 1983. Microwave and the herbarium specimen: potential dangers. *Taxon* 32: 614–615.

HILTON-TAYLOR, C. 1996. Red Data List of southern African plants. *Strelitzia* 4. National Botanical Institute, Pretoria.

HOWES, F.N. 1974. *A dictionary of useful and everyday plants and their common names* (see under *Collecting, plant*). Cambridge University Press, London.

JAIN, S.K. & RAO, R.R. 1977. *A handbook of field and herbarium methods*. Today & Tomorrow's Printers and Publishers, New Delhi.

JORGENSEN, P.M., LAWESSON, J.E. & HOLM-NIELSEN, L.B. 1984. A guide to collecting passion flowers. *Annals of the Missouri Botanical Garden* 71: 1172–1174.

KIMBERLEY, M.J. (Ed.) 1994. General notes from the National Herbarium on plant collecting. *Ingens*

Bulletin of The Aloe, Cactus and Succulent Society of Zimbabwe 10: 26–28.

KROON, K. 1998. Under petal patter: hints for pressing plants. *PlantLife* 19: 44.

LEARY, P.M. 1994. *Don't die in the bush.* Struik, Cape Town.

LEUENBERGER, B.E. 1982. Microwaves: a modern aid in preparing herbarium specimens of succulents. *The Cactus and Succulent Journal of Great Britain* 44: 42–43.

MAGILL, R.E. 1981. Collecting, preservation, study and identification of the mosses of southern Africa. *Flora of southern Africa*, Bryophyta Part 1, Fascicle 1: xi–xv. Botanical Research Institute, South Africa.

PANAGOS, M.D., & WESTFALL, R.H. 1989. Plant collecting apparatus for taxonomic and ecological studies. *Bothalia* 19: 266–274.

PRESCOTT, G.W. 1980. How to know the aquatic plants. *The Pictured Key Nature Series*. Wm. C. Brown, Dubugue, Iowa.

SAVILE, D.B.O. 1962. *Collection and care of botanical specimens*. R. Duhamel, Queen's Printer and Controller of Stationery, Ottawa.

SMITH, G.F. 1991. Preparing herbarium specimens of small succulents. *PlantLife* 5: 12.

Acknowledgements

While I was writing this book, many people have, knowingly or unknowingly, provided me with information, help and encouragement. To all of them a hearty word of thanks. I wish to thank the following people in particular: artist Gillian Condy, graphics designer Sandra Turck and photographer Adela Romanowski who teamed up to illustrate the text and design the cover; Claire Linder-Smith whose drawing appears in Figure 19; René Glen and Jacques van Rooy who contributed the sections on aquatic plants and bryophyta respectively; Kevin Balkwill who refereed the manuscript and made many valuable suggestions; Marinda Koekemoer who encouraged me throughout; Emsie du Plessis, Gerrit Germishuizen and Sarie Brink who were responsible for editing, typesetting and seeing the book through the press.

STRELITZIA

1. Botanical diversity in southern Africa. 1994. B.J. Huntley (ed.). ISBN 1-874907-25-0.
2. Cyperaceae in Natal. 1995. K.D. Gordon-Gray. ISBN 1-874907-04-8.
3. Cederberg vegetation and flora. 1996. H.C. Taylor. ISBN 1-874907-28-5.
4. Red Data List of southern African plants. 1996. Craig Hilton-Taylor. ISBN 1-874907-29-3.
5. Taxonomic literature of southern African plants. 1997. N.L. Meyer, M. Mössmer & G.F. Smith (eds). ISBN 1-874907-35-8.
6. Plants of the northern provinces of South Africa: keys and diagnostic characters. 1997. E. Retief & P.P.J. Herman. ISBN 1-874907-30-7.
7. Preparing herbarium specimens. 1999. Lyn Fish. ISBN 1-919795-38-3

MEMOIRS OF THE BOTANICAL SURVEY OF SOUTH AFRICA

(discontinued after No. 63)

Still available are:

2. Botanical survey of Natal and Zululand. 1921. R.D. Aitken & G.W. Gale.
8. Researches on the vegetation of Natal. Series II. 1925. J.W. Bews & R.D. Aitken.
17. The vegetation of the Divisions of Albany and Bathurst. 1937. R.A. Dyer.
29. The wheel-point method of survey and measurement of semi-open grasslands and karoo vegetation in South Africa. 1955. C.E.M. Tidmarsh & C.M. Havenga.
31. Studies of the vegetation of parts of the Bloemfontein and Brandfort Districts. 1958. J.W.C. Mostert.
33. The vegetation of the Districts of East London and King William's Town, Cape Province. 1962. D.M. Comins.
39. Flora of Natal. 1973. J.H. Ross. ISBN 0-621-00327-1.
41. The biostratigraphy of the Permian and Triassic. Part 3. A review of Gondwana Permian palynology with particular reference to the northern Karoo Basin, South Africa. 1977. J.M. Anderson. ISBN 0-621-03834-2.
42. Vegetation of Westfalia Estate on the north-eastern Transvaal escarpment. 1977. J.C. Scheepers. ISBN 0-621-03844-X.
43. The bryophytes of southern Africa. An annotated checklist. 1979. R.E. Magill & E.A. Schelpe. ISBN 0-621-04718-X.
44. A conspectus of the African *Acacia* species. 1979. J.H. Ross. ISBN 0-621-05309-0.
45. The plant ecology of the Isipingo Beach area, Natal, South Africa. 1980. C.J. Ward. ISBN 0-621-05307-4.
46. A phytosociological study of the Upper Orange River Valley. 1980. M.J.A. Werger. ISBN 0-621-05308-2.
47. A catalogue of South African green, brown and red algae. 1984. S.C. Seagrief. ISBN 0-621-07971-5.
49. Pattern analysis in savanna-woodlands at Nylsvley, South Africa. 1984. R.H. Whittaker, J.W. Morris & D. Goodman. ISBN 0-621-08265-1.
50. A classification of the mountain vegetation of the Fynbos Biome. 1985. B.M. Campbell. ISBN 0-621-08862-5.
52. A plant ecological bibliography and thesaurus for southern Africa up to 1975. 1986. A.P. Backer, D.J.B. Killick & D. Edwards. ISBN 0-621-08871-4.
53. A catalogue of problem plants in southern Africa, incorporating the National Weed List of South Africa. 1986. M.J. Wells, A.A. Balsinhas, H. Joffe, V.M. Engelbrecht, G. Harding & C.H. Stirton. ISBN 0-621-09688-1.
55. Barrier plants of southern Africa. 1987. L. Henderson. ISBN 0-621-10338-1.
57. Veld types of South Africa 3rd edn. 1988. J.P.H. Acocks. With separate wall map. ISBN 0-621-11394-8.
58. Grasses of southern Africa. 1990. G.E. Gibbs Russell, L. Watson, M. Koekemoer, L. Smook, N.P. Barker, H.M. Anderson & M.J. Dallwitz. ISBN 0-620-14846-2.
59. Tannin-like substances in grass leaves. 1990. R.P. Ellis. ISBN 0-620-15151-X.
60. Atlas of the leaf anatomy in *Pentaschistis* (Arundineae: Poaceae). 1991. R.P. Ellis. ISBN 0-9583205-1-9.
61. The marine red algae of Natal, South Africa: Order Gelidiales (Rhodophyta). 1992. Richard E. Norris. ISBN 1-874907-01-3.
63. Biomes of southern Africa: an objective categorization. 2nd edn. 1994. M.C. Rutherford & R.H. Westfall. ISBN 1-874907-24-2.

ANNALS OF KIRSTENBOSCH BOTANIC GARDENS

(discontinued after Vol. 19)

The following volumes are available:

14. The moraeas of southern Africa. 1986. P. Goldblatt. ISSN 0-258-3305. ISBN 0-620-09974-7.
15. The botany of the southern Natal Drakensberg. 1987. O.M. Hilliard & B.L. Burtt. ISSN 0-258-3305. ISBN 0-620-10625-5.
17. The *Lachenalia* handbook. 1988. G. Duncan. ISSN 0-258-3305. ISBN 0-620-11953-5.
18. The way to Kirstenbosch. 1988. D.P. McCracken & E.M. McCracken. ISSN 0-258-3305. ISBN 0-620-11648-X.
19. The genus *Watsonia*. 1989. P. Goldblatt. ISSN 0-258-3305. ISBN 0-620-12517-9.

ENQUIRIES:
Bookshop, National Botanical Institute, Private Bag X101, Pretoria, 0001 South Africa.
Tel. (012) 804-3200 Fax (012) 804-3211 E-mail bookshop@nbipre.nbi.ac.za

Herbarium specimens are resources that can provide valuable information on the taxa represented and on the flora and vegetation of a region. This book is aimed at:

- Students who have to prepare herbarium specimens as part of a course.
- Professionals who have to submit plants for identification.
- Landowners who want to establish their own reference herbarium of the plants on their property.
- Amateurs who would like to contribute to an inventory of our flora.
- Those just starting their career at a herbarium.
- Anyone who has to begin a new herbarium.

In the light of the cost, effort and time involved in establishing and maintaining a herbarium, specimens should be prepared in such a way that they would serve their purpose for hundreds of years. The techniques described in the book will guide the reader to:

- Include as many characters of a plant as possible when collecting material.
- Press specimens in such a way that all or most of the characters will show.
- Dry the pressed material carefully so that the specimens remain intact.
- Provide comprehensive label information, covering especially those aspects not obtainable from the pressed material but nevertheless important to the knowledge of the taxon concerned and the vegetation of the region.
- Mount specimens properly, making them easily accessible for study and preventing damage when they are handled and stored.

NATIONAL
BOTANICAL
INSTITUTE